Appendix to

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Appendix to:
A Model for International Spillovers in Commodity Exporters

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Appendix A: Other results for SVAR analysis with the US

Figure A1: SVAR - World commodity supply shocks in South Africa

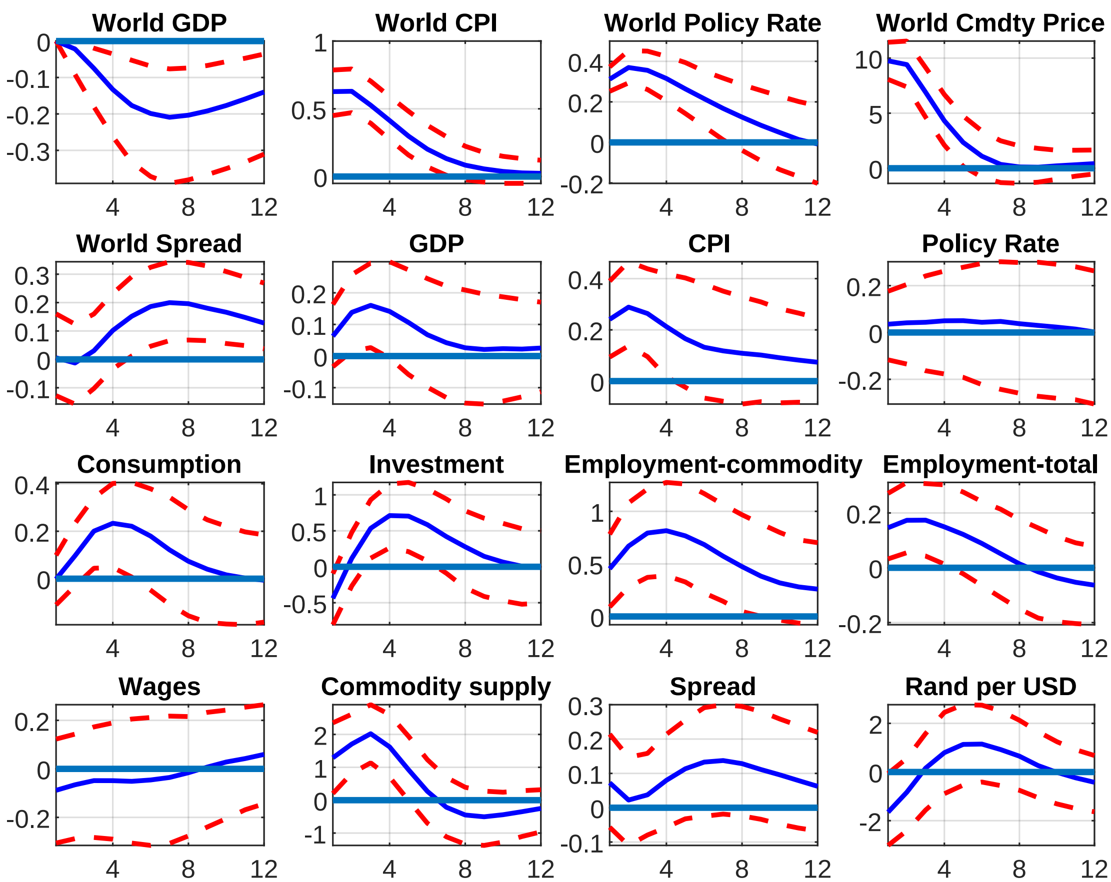


Figure A2: SVAR - World productivity shocks in South Africa

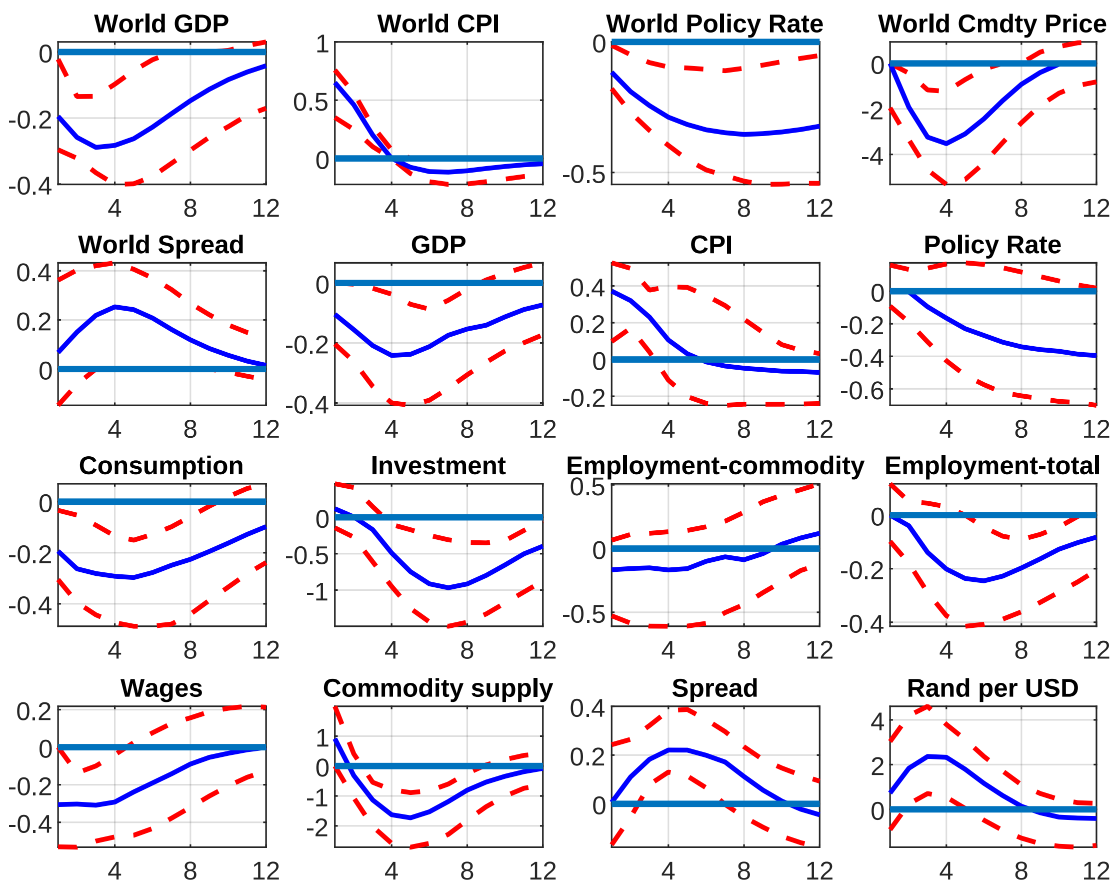


Figure A3: SVAR - World commodity supply shocks in Canada

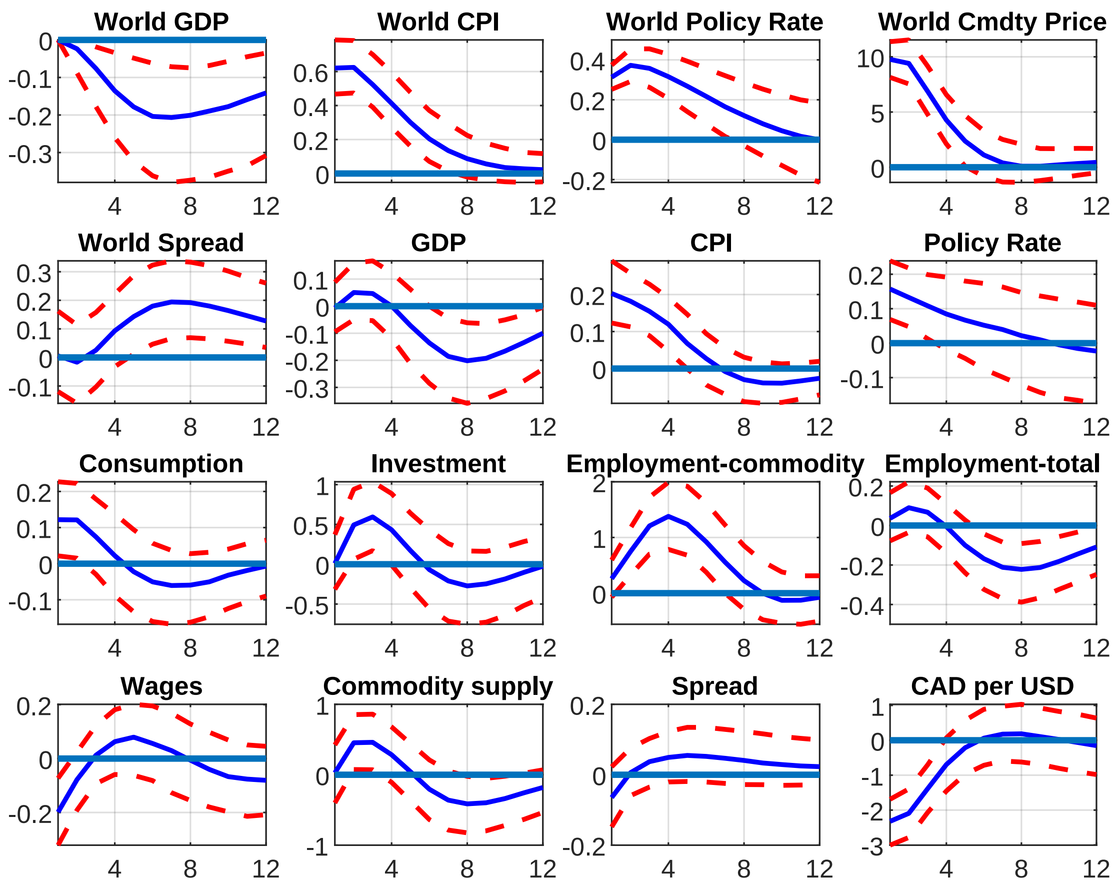
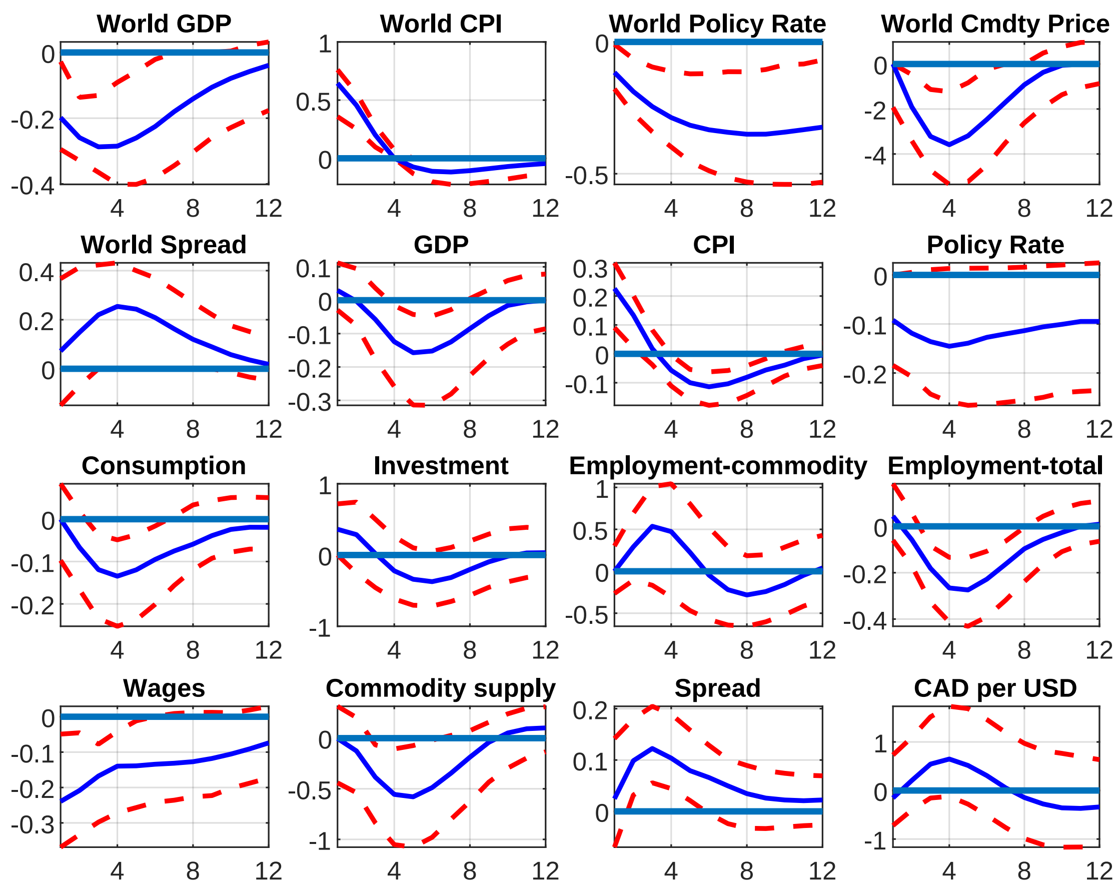


Figure A4: SVAR - World productivity shocks in Canada



Appendix B: SVAR analysis with OECD-BRIIC

Figure B1: SVAR - World aggregate demand shocks in South Africa

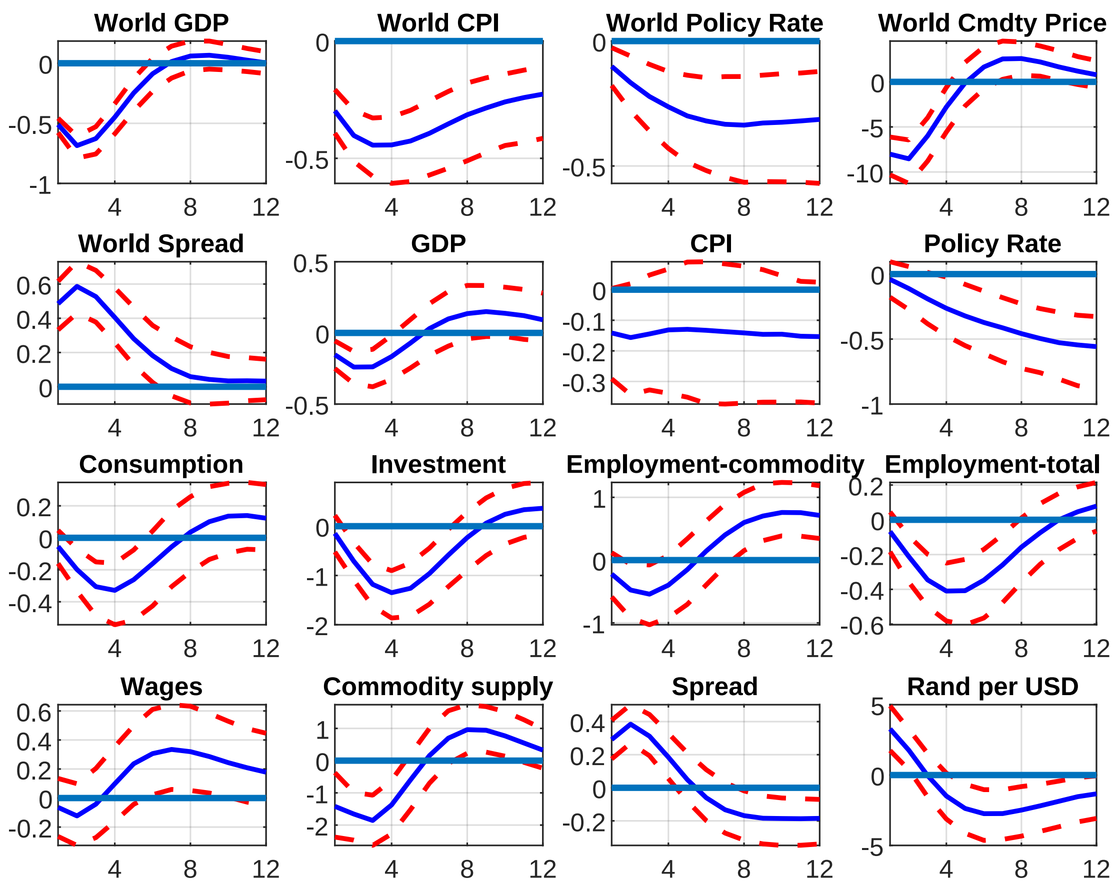


Figure B2: SVAR - World commodity shocks in South Africa

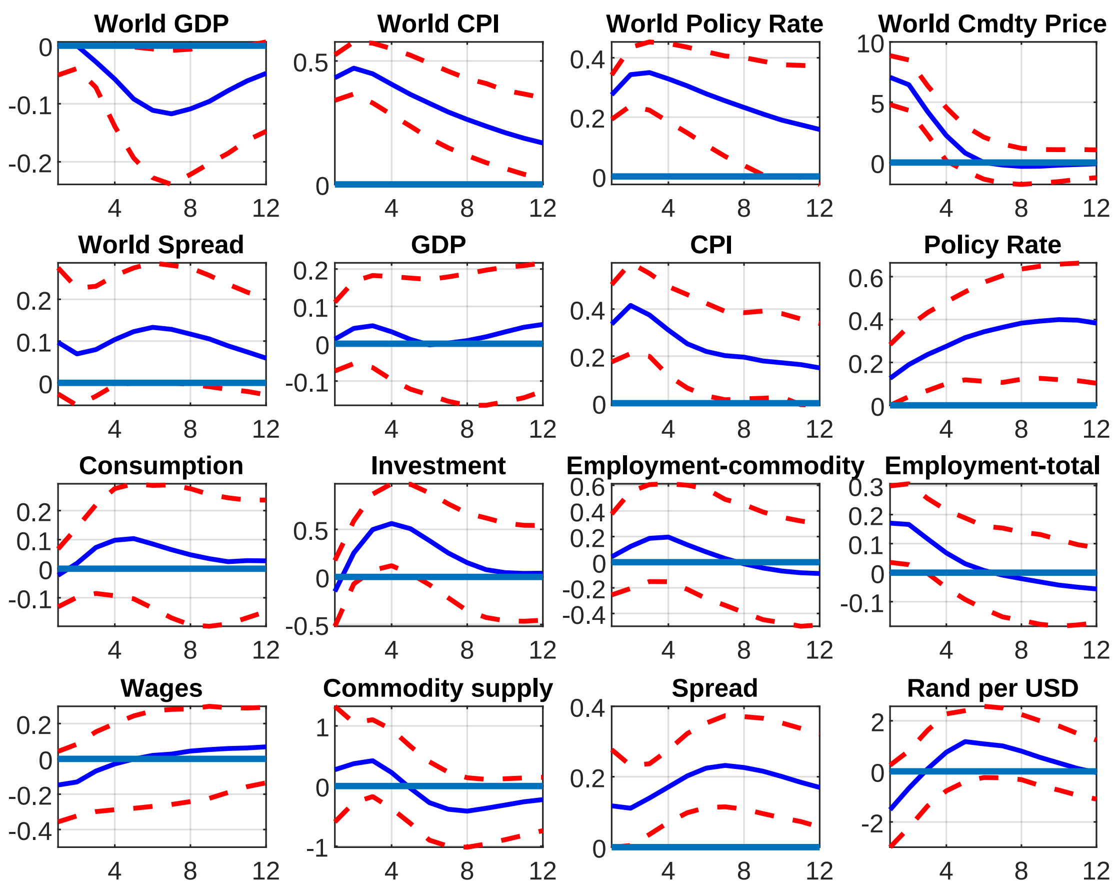


Figure B3: SVAR - World productivity shocks in South Africa

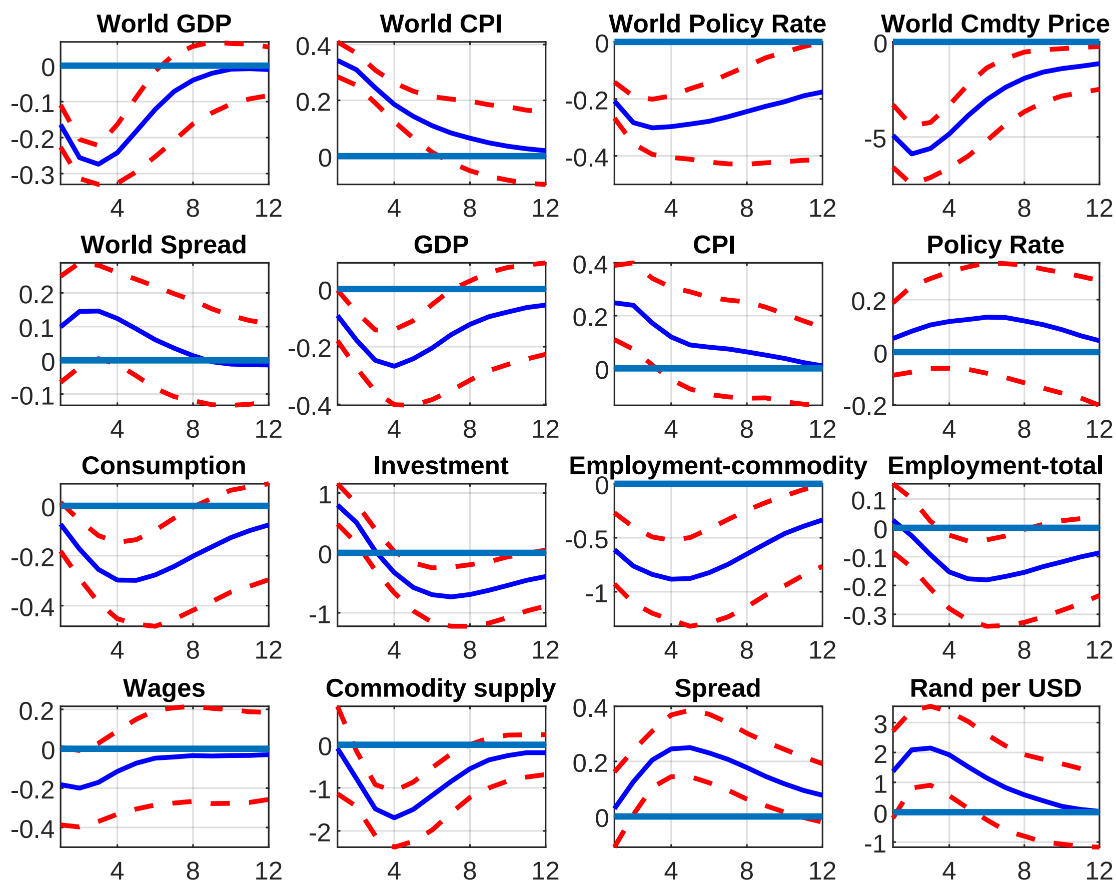


Figure B4: SVAR - World aggregate demand shocks in Canada

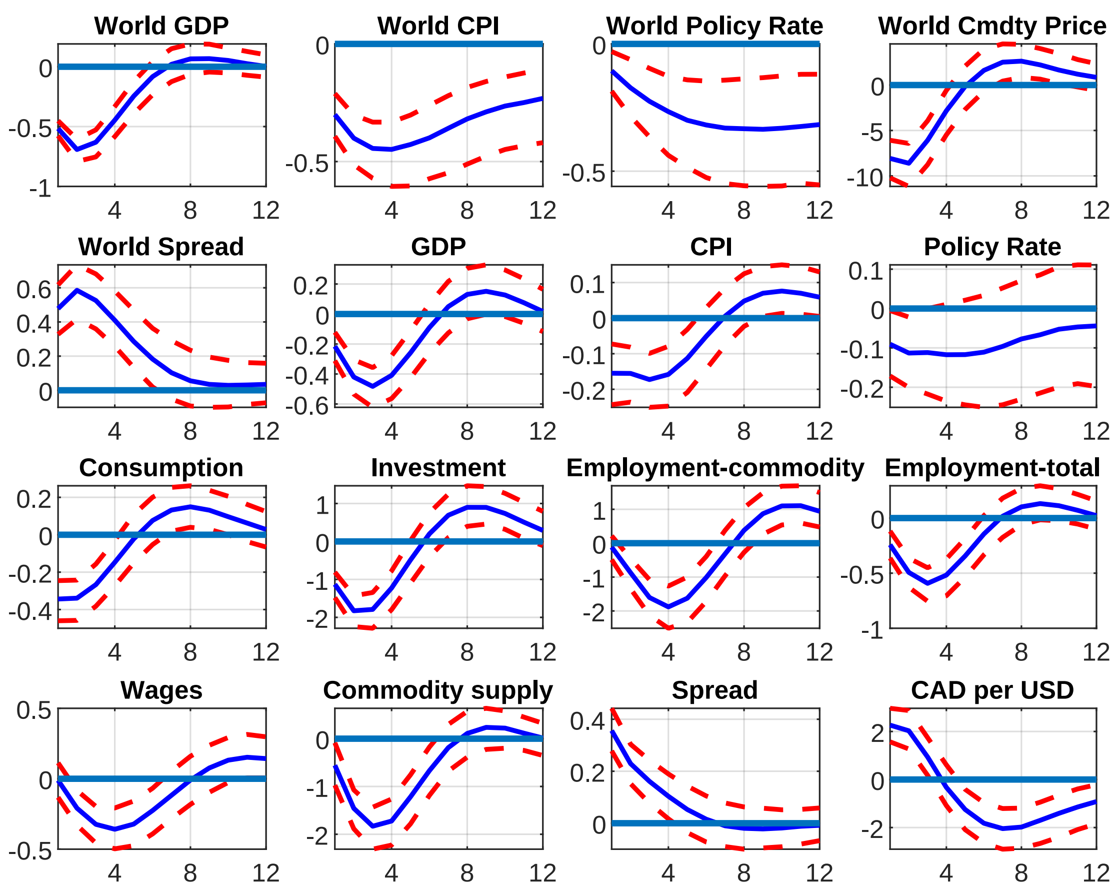


Figure B5: SVAR - World commodity shocks in Canada

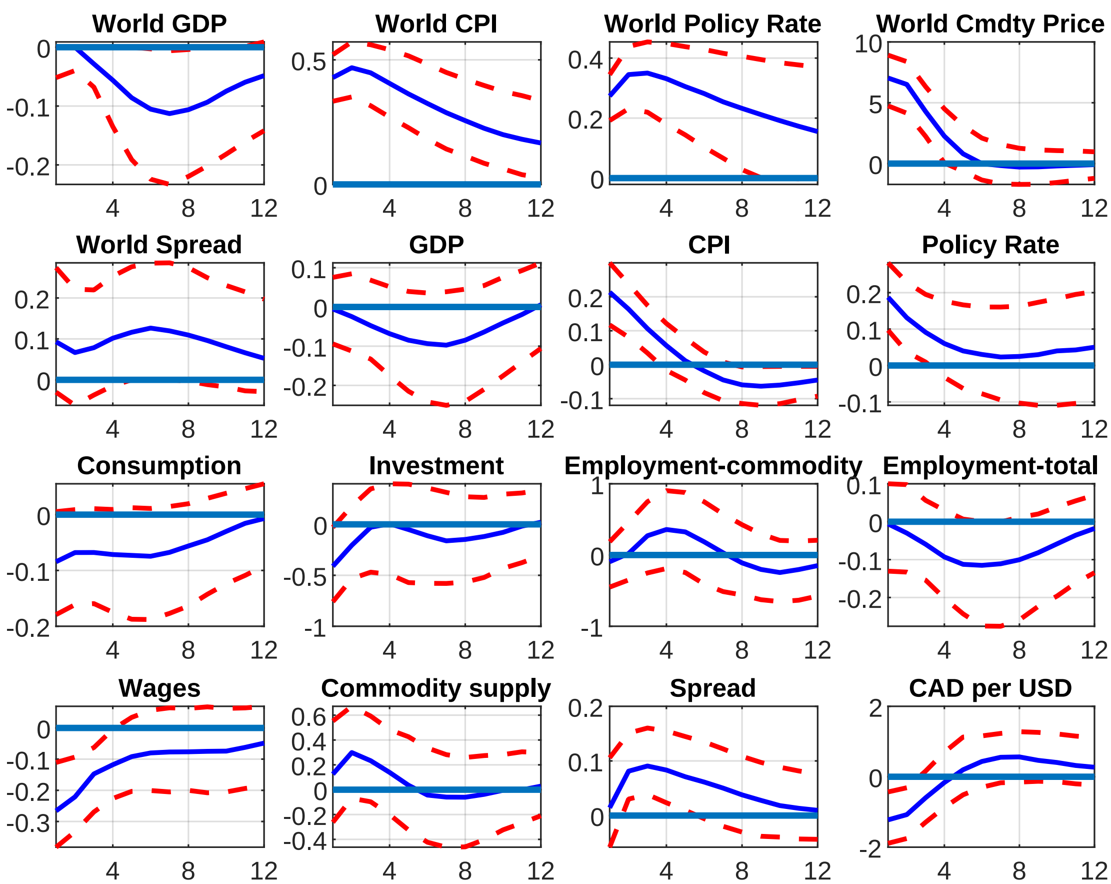
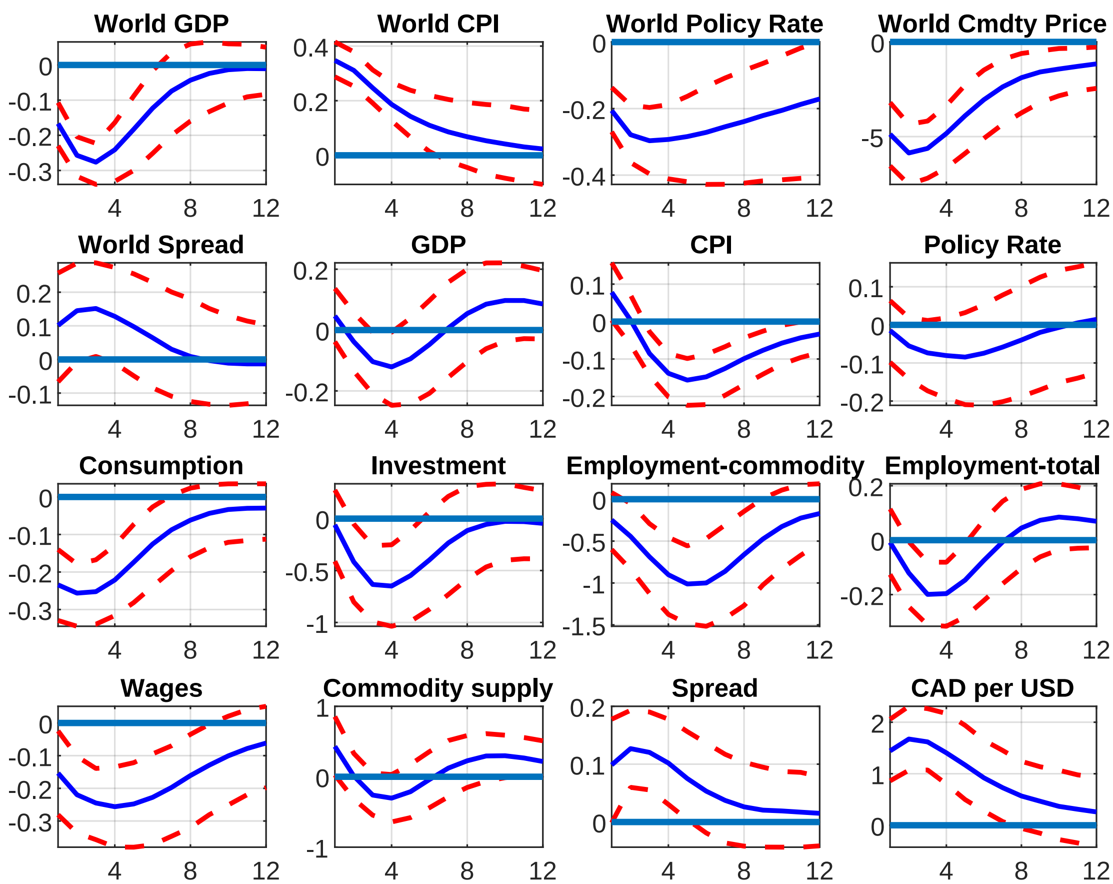


Figure B6: SVAR - World productivity shocks in Canada



Appendix C: model's FOC

Here we present the First Order Conditions (FOC) from savers, entrepreneurs and the firms. The central bank, the government and rule of thumb households do not optimize but follow simple rules described in the paper. FOC from the financial sector are presented in the core of the paper but we here detail our simple agency problem and compare it to Bernanke et al. (1999).

C.1 Households

The consumption demand functions for the domestic and the imported goods are given by:

$$C_t^d = (1-\omega_c)\left[\frac{P_t}{P_t^c}\right]^{-\eta} C_t, \tag{1}$$

$$C_t^m = \omega_c\left[\frac{P_t^m}{P_t^c}\right]^{-\eta} C_t, \tag{2}$$

where P_t is the domestic good price, P_t^m the imported good price and P_t^c represents the Consumer price index (CPI) and is given by:

$$P_t^c = \left[(1-\omega_c)(P_t)^{1-\eta} + \omega_c(P_t^m)^{1-\eta}\right]^{1/(1-\eta)}.$$

C.1.1 Savers

Savers maximize their utility with respect to domestic and foreign bonds holding and consumption. The First Order Conditions (FOCs) associated with IHs with shadow value υ_t^s on their budget constraint are given by:

$$w.r.t.\ C_t^I \quad : \quad \left(C_t^s - bC_{t-1}^s\right)^{-\sigma_c} = \psi_t^s \frac{P_t^c}{P_t} \tag{3}$$

$$w.r.t.\ B_{t+1} \quad : \quad \psi_t^s = \beta \mathrm{E}_t \frac{\psi_{t+1}^s}{\pi_{t+1}} \varepsilon_{b,t} R_t \tag{4}$$

$$w.r.t.\ B_{t+1}^* \quad : \quad \psi_t^s = \beta \mathrm{E}_t \frac{\psi_{t+1}^s}{\pi_{t+1}} \frac{S_{t+1}}{S_t} R_t^* \Phi(A_t, \tilde{\phi}_t) \tag{5}$$

where the Lagrange multiplier is redefined as $\psi_t^s = \upsilon_t^s P_t$.

Country risk premium Combining the FOC with respect to domestic and foreign bonds gives the uncovered interest rate parity (UIP) condition

$$R_t = R_t^* \Phi(A_t, \tilde{\phi}_t) \mathrm{E}_t \frac{S_{t+1}}{S_t} \tag{6}$$

This equality shows that the spread between domestic and foreign nominal risk free rates depends on the anticipated domestic currency depreciation, the country-wide foreign debt and an UIP shock.

Wage setting Optimization in the primary and secondary sector are similar, and simply gives two wage-Phillips curves. We thus here drop the p of f indexes from the wage and hours to simplify the notations. Each household has a probability $(1-\xi_w)$ to be allowed to optimally reset the nominal wage. Otherwise, the wage is indexed on previous period consumer price inflation π^c_{t-1}. Households that can re-optimize their wage maximize

$$\sum_{s=0}^{\infty}(\beta\xi_w)^s\left(\upsilon^s_{t+s}W_{j,t+s}h_{j,t+s}-A_h\frac{(h_{j,t+s})^{1+\sigma_h}}{1+\sigma_h}\right)$$

where

$$\begin{aligned} W_{j,t+s} &= W^{new}_{j,t}\left(\pi^c_t...\pi^c_{t+s-1}\right)^{\kappa_w} \\ h_{j,t+s} &= \left(\frac{W_{j,t+s}}{W_{t+s}}\right)^{-\epsilon_w}H^S_{t+s}=\left(\frac{W^{new}_{j,t}\left(\pi^c_t...\pi^c_{t+s-1}\right)^{\kappa_w}}{W_{t+s}}\right)^{-\epsilon_w}H^s_{t+s} \end{aligned}$$

with respect to the new wage W^{new}_t. It is also useful to define

$$\begin{aligned} \Pi^c_{t,t+s-1} &= (\pi^c_t...\pi^c_{t+s-1}) \\ \Pi_{t+1,t+s} &= (\pi_{t+1}...\pi_{t+s}) \end{aligned}$$

Rearranging using the above equations gives:

$$\sum_{s=0}^{\infty}(\beta\xi_w)^s\left[\upsilon^s_{t+s}W^{new}_{j,t}\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}\left(\frac{W^{new}_{j,t}\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{W_{t+s}}\right)^{-\epsilon_w}H^s_{t+s}\right.$$
$$\left.-\frac{A_h}{1+\sigma_h}\left(\frac{W^{new}_{j,t}\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{W_{t+s}}\right)^{-(1+\sigma_h)\epsilon_w}\left(H^s_{t+s}\right)^{1+\sigma_h}\right]$$

Expressing it in term of real wage and simplifying gives:

$$\sum_{s=0}^{\infty}(\beta\xi_w)^s\left[\psi^s_{t+s}\left(\frac{\bar{w}^{new}_{j,t}\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{\Pi_{t+1,t+s}}\right)^{1-\epsilon_w}\left(\bar{w}_{t+s}\right)^{\epsilon_w}H^s_{t+s}\right.$$
$$\left.-\frac{A_h}{1+\sigma_h}\left(\frac{\bar{w}^{new}_{j,t}\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{\bar{w}_{t+s}\Pi_{t+1,t+s}}\right)^{-(1+\sigma_h)\epsilon_w}\left(H^s_{t+s}\right)^{1+\sigma_h}\right]$$

The FOC is now easy to derive and reads:

$$(\epsilon_w-1)\left(\bar{w}^{new}_{j,t}\right)^{-\epsilon_w}\sum_{s=0}^{\infty}(\beta\xi_w)^s\psi^s_{t+s}\left(\frac{\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{\Pi_{t+1,t+s}}\right)^{1-\epsilon_w}\left(\bar{w}_{t+s}\right)^{\epsilon_w}H^s_{t+s}$$
$$=\epsilon_w\left(\bar{w}^{new}_{j,t}\right)^{-(1+\sigma_h)\epsilon_w-1}\sum_{s=0}^{\infty}(\beta\xi_w)^sA_h\left(\frac{\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{\bar{w}_{t+s}\Pi_{t+1,t+s}}\right)^{-(1+\sigma_h)\epsilon_w}\left(H^s_{t+s}\right)^{1+\sigma_h}$$

which simplifies to (we drop the j as all re-optimising households set the same wage):

$$\left(\bar{w}_t^{new}\right)^{1+\sigma_h\epsilon_w} = \frac{\epsilon_w}{\epsilon_w - 1} \frac{\sum_{s=0}^{\infty} (\beta\xi_w)^s A_h \left(\frac{\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{\bar{w}_{t+s}\Pi_{t+1,t+s}}\right)^{-(1+\sigma_h)\epsilon_w} \left(H^s_{t+s}\right)^{1+\sigma_h}}{\sum_{s=0}^{\infty} (\beta\xi_w)^s \psi^s_{t+s} \left(\frac{\left(\Pi^c_{t,t+s-1}\right)^{\kappa_w}}{\Pi_{t+1,t+s}}\right)^{1-\epsilon_w} \left(\bar{w}_{t+s}\right)^{\epsilon_w} H^s_{t+s}}$$

This last equation is the wage-Phillips curve with partial indexation. In Dynare, the infinite sum can be rewritten as a set of three equations:

$$\left(\bar{w}_t^{new}\right)^{1+\sigma_h\epsilon_w} = \left(\frac{\epsilon_w}{\epsilon_w - 1}\right) \frac{X^H_{1,t}}{X^H_{2,t}} \tag{7}$$

$$X^H_{1,t} = A_h \bar{w}_t^{(1+\sigma_h)\epsilon_w} \left(H^s_t\right)^{1+\sigma_h} + \beta\xi_w \left(\frac{\left(\pi^c_t\right)^{\kappa_w}}{\pi_{t+1}}\right)^{-(1+\sigma_h)\epsilon_w} \mathrm{E}_t X^H_{1,t+1} \tag{8}$$

$$X^H_{2,t} = \psi^s_t \bar{w}_t^{\epsilon_w} H^s_t + \beta\xi_w \left(\frac{\left(\pi^c_t\right)^{\kappa_w}}{\pi_{t+1}}\right)^{-(\epsilon_w-1)} \mathrm{E}_t X^H_{2,t+1} \tag{9}$$

Labor packer The real wage index evolves according to

$$\bar{w}_t^{1-\epsilon_w} = (1-\xi_w)\left(\bar{w}_t^{new}\right)^{1-\epsilon_w} + \xi_w \left(\frac{\left(\pi^c_{t-1}\right)^{\kappa_w} \bar{w}_{t-1}}{\pi_t}\right)^{1-\epsilon_w} \tag{10}$$

C.1.2 Entrepreneurs

Each entrepreneur j maximizes her utility with respect to consumption and borrowing with shadow value υ^e_t on the budget constraint:

$$w.r.t.\ C^e_t \quad : \quad \left(C^e_t - bC^e_{t-1}\right)^{-\sigma_c} = \psi^e_t \frac{P^c_t}{P_t} \tag{11}$$

$$w.r.t.\ B^e_{t+1} \quad : \quad \psi^e_t = \beta_E \mathrm{E}_t \frac{\psi^e_{t+1}}{\pi_{t+1}} R^L_t \tag{12}$$

Entrepreneurs also maximize their utility with respect to the capital stock, investment and capital utilization rate in sector q:

$$w.r.t.\ K^q_{t+1} \quad : \quad \psi^e_t \frac{P^{k,q}_t}{P_t} = \beta_E \psi^e_{t+1} \left(r^{k,q}_{t+1} + (1-\delta)\frac{P^{k,q}_{t+1}}{P_{t+1}}\right) \tag{13}$$

$$\begin{aligned} w.r.t.\ I^q_t \quad : \quad & -\psi^e_t \frac{P^i_t}{P_t} + \frac{P^{k,q}_t}{P_t} \psi^e_t \Upsilon_t \left(1 - \tilde{S}\left(\frac{I^q_t}{I^q_{t-1}}\right) - \tilde{S}'\left(\frac{I^q_t}{I^q_{t-1}}\right)\frac{I^q_t}{I^q_{t-1}}\right) \\ + \quad & \beta_E \mathrm{E}_t \left(\frac{P^{k,q}_{t+1}}{P_{t+1}} \psi^e_{t+1} \Upsilon_{t+1} \tilde{S}'\left(\frac{I^q_{t+1}}{I^q_t}\right)\left(\frac{I^q_{t+1}}{I^q_t}\right)^2\right) = 0 \end{aligned} \tag{14}$$

where $r^k_t \equiv \frac{R^k_t}{P_t}$ is the real rental rate of capital.

Investment Basket Domestic and imported investments are given by:

$$I_t^{d,p} = (1-\omega_i)\left[\frac{P_t}{P_t^i}\right]^{-\eta} I_t^p, \tag{15}$$

$$I_t^{m,p} = \omega_i \left[\frac{P_t^m}{P_t^i}\right]^{-\eta} I_t^p, \tag{16}$$

where P_t^i is the aggregate investment price given by:

$$P_t^i = \left[(1-\omega_i)(P_t)^{1-\eta} + \omega_i (P_t^m)^{1-\eta}\right]^{1/(1-\eta)}$$

C.2 Firms

Here we present the profit maximization problem of the firms in the commodity and manufacturing sectors.

C.2.1 Commodity sector

Commodity producers combine capital K_t^p, labor H_t^p and land L_t^p to produce a commodity input. It gives the capital to labor ratio:

$$\frac{K_t^p}{H_t^p} = \left(\frac{\alpha_p \bar{w}_t^p}{(1-\alpha_p-\beta_p) r_t^{k,p}}\right)^{\sigma_p} \left(\frac{H_0^p}{\epsilon_{h,t}\epsilon_{hp,t} K_0^p}\right)^{\sigma_p - 1}, \tag{17}$$

and the capital to land ratio

$$\frac{K_t^p}{L_t^p} = \left(\frac{\beta_p r_t^{l,p}}{(1-\alpha_p-\beta_p) r_t^{k,p}}\right)^{\sigma_p} \left(\frac{L_0^p}{K_0^p}\right)^{\sigma_p - 1}, \tag{18}$$

where $r_t^{l,p}$ is the rental rate of land. Profits maximization also gives a relation between commodity price (in domestic currency) and marginal production costs is given by

$$\frac{S_t P_t^{*p}}{P_t} = \left[\alpha_p \left(\frac{r_t^{k,p}}{r^{k,p}}\right)^{1-\sigma_p} + \beta_p \left(\frac{r_t^{k,l}}{r^{k,l}}\right)^{1-\sigma_p} + (1-\alpha_p-\beta_p)\left(\frac{\bar{w}_t^p R_t^L}{\epsilon_{h,t}\epsilon_{hp,t}\bar{w}^p R^L}\right)^{1-\sigma_p}\right]^{\frac{1}{1-\sigma_p}} \tag{19}$$

where variables without a subscript t correspond to their values at steady-state.

C.2.2 Secondary sector

Secondary good producers In the first step, cost minimization problem for the intermediate firm i in period t gives the capital to labor ratio:

$$\frac{K_t^f}{H_t^f} = \frac{\alpha \bar{w}_t^f}{(1-\alpha) r_t^{k,f}}, \tag{20}$$

As well as the equilibrium real marginal cost of the domestic input mc_t^{nd}, which, using the steady-state relationships described in the next subsection simplifies to:

$$mc_t^{nd} = \left(\frac{r_t^{k,f}}{r^{k,f}}\right)^{\alpha} \left(\frac{\bar{w}_t^f}{\epsilon_{h,t}\bar{w}^f}\right)^{1-\alpha} \tag{21}$$

The second step, yields the domestic to foreign input ratio

$$\frac{N_t^m}{N_t^d} \quad = \quad \left(\frac{\omega_n}{1-\omega_n}\frac{mc_t^{nd}}{P_t^{m,n}/P_t}\right)^{\sigma_n} \left(\frac{N_0^d}{N_0^m}\right)^{\sigma_n - 1}, \tag{22}$$

as well as the real marginal cost mc_t of the final good:

$$mc_t = \frac{1}{\lambda_d}\left[\omega_n \left(\frac{P_t^{m,n}}{P_t}\right)^{1-\sigma_n} + (1-\omega_n)\left(mc_t^{nd}\right)^{1-\sigma_n}\right]^{\frac{1}{1-\sigma_n}} \tag{23}$$

where $\frac{P_t^{m,n}}{P_t}$ is the real price of the imported input (see the importing distributors subsection for more details).

Domestic Distributors The profit maximization problem for the final good distributor gives the following first order condition:

$$\frac{Y_{i,t}^f}{Y_t^f} = \left(\frac{P_t}{P_{i,t}}\right)^{\frac{\lambda_{d,t}}{\lambda_{d,t}-1}} \tag{24}$$

where P_t is the price for the homogeneous final good and $P_{i,t}$ is the input price for the intermediary good i, taken as given by the final good firm. The price index P_t is given by:

$$P_t = \left[\int_0^1 P_i^{\frac{1}{1-\lambda_{d,t}}} di\right]^{(1-\lambda_{d,t})} \tag{25}$$

The optimization problem faced by the intermediate distributor i when setting its price at time t taking aggregator's demand as given reads:

$$\max_{P_t^{new}} \mathrm{E}_t \sum_{s=0}^{\infty} (\beta_E \xi_d)^s v_{t+s}^e [((\pi_t \pi_{t+1} \ldots \pi_{t+s-1})^{\kappa_d} P_t^{new})\, Y_{i,t+s}^f - MC_{i,t+s} Y_{i,t+s}^f], \tag{26}$$

where $(\beta_E \xi_d)^s v_{t+s}^e$ is a stochastic discount factor, v_{t+s}^e the marginal utility of entrepreneurs' nominal income in period $t+s$ and $MC_{i,t}$ is the firm's nominal marginal cost. Using (24) the first order condition for this optimization problem can be written as:

$$\mathrm{E}_t \sum_{s=0}^{\infty} (\beta_E \xi_d)^s \psi^e_{t+s} \left(\frac{(\pi_t \pi_{t+1} \dots \pi_{t+s-1})^{\kappa_d}}{(\pi_{t+1}\pi_{t+2} \dots \pi_{t+s})} \right)^{-\frac{\lambda_{d,t+s}}{\lambda_{d,t+s}-1}} Y^d_{t+s} \times \tag{27}$$
$$\left[\frac{(\pi_t \pi_{t+1} \dots \pi_{t+s-1})^{\kappa_d}}{(\pi_{t+1}\pi_{t+2} \dots \pi_{t+s})} \frac{P^{new}_t}{P_t} - \frac{\lambda_{d,t} MC_{\iota,t+s}}{P_{t+s}} \right] = 0.$$

which gives the price Phillips-Curve.

Importing and exporting distributors The importing firms price setting problem is similar to the domestic good price setting problem presented above. In particular, the final good import price setting problem follows Adolfson et al. (2007) and gives a standard Phillips-Curve for P^{m}_t[1]. We thus refer to their paper for the details on the derivations. The input import price setting is also standard with one point of attention. The imported input is Leontief basket composed of commodities and foreign intermediate inputs. When setting the imported input price $P^{m,n}_t$, distributors thus consider the following marginal cost: $MC^{m,n}_t = \omega_p S_t P^*_t + (1-\omega_p) S_t \frac{MC^*_t}{MC^*}$ where MC^*_t is the marginal cost in the foreign economy. Note the presence of the steady-state marginal cost in this expression: this is equivalent to imposing a mark-up on the foreign imported intermediate input, and implies that the import price is equal to one at steady-state. Optimisation in the exporting firms price setting problem is similar to the domestic good price setting problem presented above and also follows Adolfson et al. (2007).

C.6 Foreign secondary good producers and commodity demand

In the first step, cost minimization problem for the foreign secondary good producer in period t gives a capital to labor ratio analogue to equation (20) and the marginal production cost:

$$\frac{MC^{n*}_t}{P^*_t} = \left(\frac{r^{k,*}_t}{r^{k,*}} \right)^{\alpha^*} \left(\frac{\bar{w}^*_t}{\epsilon^*_{h,t} \bar{w}^*} \right)^{1-\alpha^*} \tag{28}$$

In the second step, firms combine this intermediate input with commodities. Demand for commodities $Y^{pD*}_t = Y^{p*}_t$ thus derive from:

$$\frac{Y^{p*}_t}{N^*_t} = \left(\frac{\beta^*}{1-\beta^*} \frac{MC^{n*}_t}{P^{p*}_t} \right)^{\sigma^*_p} \left(\frac{N^*_0}{Y^{pD*}_0} \right)^{\sigma^*_p - 1}, \tag{29}$$

which can be rewritten as

$$\frac{P^{p*}_t}{MC^{n*}_t} = \left(\frac{\beta^*}{1-\beta^*} \frac{N^*_t}{Y^{p*}_t} \right)^{1/\sigma^*_p}. \tag{30}$$

[1] The only difference with Adolfson et al. (2007) is that they make a distinction between final consumption and final investment goods, while we only consider one Phillips curve for final good imports.

When aggregate demand increases, firms extend supply by increasing their use of labor and capital (thus N_t^* increases). As commodity supply $Y_t^{pS*} = Y_t^{p*}$ is exogenous, the price of commodities (relative to the cost of other production factors) increases. Equation (30) thus shows that when the elasticity of commodity demand σ_p^* is low, changes in aggregate demand translate into large commodity price fluctuations.

C.7 The agency problem in the financial sector

We first present the domestic bank problem and then discuss the impact of foreign banks. We assume that entrepreneurs have the option to cheat: they can default on their loans and run-away with a fraction of their assets. Banks thus requires entrepreneurs to pledge their assets as collateral, and the fraction of assets that entrepreneurs can divert is a function of the banks' monitoring efforts. Banks choose the fraction of entrepreneur's assets under monitoring, and this fraction is impossible to divert. Entrepreneur j cheats when the value of divertable assets is larger than the value of its total assets net of its debt, when

$$(1 - \vartheta_{j,t})V_{j,t} > V_{j,t} - B_{j,t} \tag{31}$$

where $V_{j,t} = P_t^k K_{j,t}$ is the value of entrepreneur j assets, $B_{j,t}$ the debt (bank loan) and $\vartheta_{j,t}$ the fraction of its assets under monitoring. Since monitoring is costly (see below), the bank sets its monitoring effort such that this expression holds with equality (and entrepreneurs have no incentives to cheat):

$$\vartheta_{j,t} = \frac{B_{j,t}}{V_{j,t}} \tag{32}$$

In this expression, we can drop the j as all entrepreneurs are identical (due to trade in state contingent securities).

We assume that banks take this monitoring rate as given and that their total monitoring cost is the product of the monitoring rate and their total loan books. Banks thus maximize:

$$\left(R_t^{L,d} - R_t\right) B_t - \left(\phi_m \vartheta_t + \phi_{fc}\right) B_t \tag{33}$$

where $R_t^{L,d}$ is the domestic bank lending rate, ϕ_m capture monitoring costs and ϕ_{fc} is a fixed lending cost (allowing us to calibrate the spread at steady-state). The FOC (w.r.t. B_t) gives the domestic bank lending rate:

$$R_t^{L,d} = R_t + \phi_{fc} + \phi_m \vartheta_t \tag{34}$$

which is equivalent to:

$$R_t^{L,d} = R_t + \phi_{fc} + \phi_m \frac{B}{V} \left(\frac{B_t/B}{V_t/V}\right) \tag{35}$$

and to the equation presented in the paper (we just abstract from the exogenous shock to simplify the exposition):

$$R_t^{L,d} = R_t + \phi_{fc} + \phi_{nw} \left(\frac{B_t/B}{V_t/V}\right) \tag{36}$$

where $\phi_{nw} = \phi_m B/V$ is the spread elasticity to leverage capturing a financial accelerator.

Foreign banks face an identical agency problem on the foreign market and thus set a spread based on foreign entrepreneurs' leverage as described in the paper:

$$R_t^{L,*} = R_t^* + \phi_{fc}^* + \phi_{nw}^* \left(\frac{B_t^*/B^*}{V_t^*/V^*} \right) \tag{37}$$

Now, remember our assumption that the SOE is too small to have an impact on foreign banks, and that foreign banks do not discriminate between domestic and foreign borrowers when setting their spread. Foreign banks thus set the same spread when lending to domestic or foreign entrepreneurs for domestic currency loans:

$$R_t^{L,f} = R_t + \phi_{fc}^* + \phi_{nw}^* \left(\frac{B_t^*/B^*}{V_t^*/V^*} \right) \tag{38}$$

One interpretation is that foreign banks are free-riders in the domestic market as they ignore monitoring-costs when setting the rate at which domestic entrepreneurs can borrow at the foreign bank. As every entrepreneur borrows a fixed share ω_b of its credit need at foreign banks and the rest at a domestic bank, every domestic entrepreneur is monitored and has no incentive to divert assets.

How do our assumptions compare to BGG? Once linearized, equation (36) yields

$$\hat{R}_t^{L,d} = \frac{R}{R^L}\hat{R}_t + \frac{\phi_{nw}}{R^L}\left(\hat{B}_t - \hat{V}_t\right). \tag{39}$$

Combined with the linearized version of (38), one can get the average spread paid by domestic entrepreneurs:

$$\hat{R}_t^{L} = \frac{R}{R^L}\hat{R}_t + (1-\omega_b)\left[\frac{\phi_{nw}}{R^L}\left(\hat{B}_t - \hat{V}_t\right)\right] + \omega_b\left[\frac{\phi_{nw}^*}{R^L}\left(\hat{B}_t^* - \hat{V}_t^*\right)\right]. \tag{40}$$

where ω_b is the share of foreign banks in the domestic economy. Combined with the entrepreneurs FOCs, we have

$$\mathrm{E}_t\hat{R}_{t+1}^{K} = \frac{R}{R^L}\hat{R}_t + (1-\omega_b)\left[\frac{\phi_{nw}}{R^L}\left(\hat{B}_t - \hat{V}_t\right)\right] + \omega_b\left[\frac{\phi_{nw}^*}{R^L}\left(\hat{B}_t^* - \hat{V}_t^*\right)\right]. \tag{41}$$

where R_t^K is the nominal return on capital.

This is close to BGG key equation $\mathrm{E}_t\hat{R}_{t+1}^{K} = \hat{R}_t + \phi_{BGG}\left(total\ \hat{assets}_t - net\ \hat{worth}_t\right)$ with two important differences. First, we use an alternative measure of leverage: while BGG uses a total asset to net worth ratio, we use a credit to collateral ratio The second (and most important to our paper) difference with BGG is that we combine domestic and foreign banks. The spread paid by domestic entrepreneurs is thus affected by both domestic and foreign financing conditions. Note rescaling by R^L has virtually no impact as it is close to one.

Appendix D: model's steady state

Here we provide the details on the computation of steady-state for the domestic economy.

Calibration and choice of units First we fix some values reflecting some freedom in the choice of units:

$$\begin{aligned} y^f &= Y_0^f = 1 \\ h &= h^f + h^p = 0.3 \end{aligned}$$

where $Y_0^f = 1$ is a normalization and $h = 0.3$ ensures that agents devote on average 30% of their time to labor activities. It implies that hours worked by savers and rule of thumb consumers in each sectors is given by $H^{s,p} = H^{r,p} = \omega_h h$ and $H^{s,f} = H^{r,f} = (1-\omega_h)h$. Total hours available to the firms in each sector is thus given by $H^p = H^{s,p} + H^{r,p}$ and $H^f = H^{s,f} + H^{r,f}$. We calibrate $A_{h,p}$ and $A_{h,f}$ to match these targets.

We assume that inflation and the risk-free rates are the same in the domestic and foreign economies ($\pi = \pi^* = 1$ and $R = R^* = 1/\beta$). These assumptions imply that $dS = 1$ (through the UIP condition). Therefore, all inflation rates are equal to one. We then calibrate R^L to match a target for the spread. With entrepreneurs FOC we thus get $\beta_E = \frac{1}{R^L}$

Entrepreneurs Turning to entrepreneurs FOCs, the assumptions presented above allow to pin down the real price of capital and its rental rate to

$$\begin{aligned} p_{k'} &= \frac{P^k}{P} = \frac{P^i}{P} = 1 \\ r^k &= \frac{p_{k'}(1-(1-\delta)\beta_E)}{\beta_E} \end{aligned}$$

Final good sector Turning to final good distributors, the marginal costs are given by:

$$mc = mc^x = mc^m = \lambda_d$$

Of course, in the perfectly competitive producing sectors, real marginal cost is given by

$$mn^{nd} = 1$$

The normalized CES production function in the final good sector implies that

$$\frac{MC}{P}Y^f = \frac{P^{m,n}}{P}N^m + \frac{MC^{nd}}{P}N^d$$

where the domestic and foreign input shares are given by

$$\begin{aligned} \frac{P^{m,n}}{P}N^m &= \omega_n \frac{MC}{P}Y^f \\ \frac{MC^{nd}}{P}N^d &= (1-\omega_n)\frac{MC}{P}Y^f \end{aligned}$$

and thus:

$$\begin{aligned} N^m &= \omega_n mc\, Y^f \\ N^d &= (1-\omega_n) mc\, Y^f \end{aligned}$$

Similarly,

$$\begin{aligned} r^{k,f} K^f &= \alpha \frac{MC^{nd}}{P} N^d \\ \bar{w}^f H^f &= (1-\alpha) \frac{MC^{nd}}{P} N^d \end{aligned}$$

such that

$$\begin{aligned} K^f &= \frac{\alpha mc^{nd} N^d}{r^k} \\ \bar{w}^f &= \frac{(1-\alpha) mc^{nd} N^d}{H^f} \end{aligned}$$

and wages are equal across sectors at steady-state so $\bar{w} = \bar{w}^p = \bar{w}^f$. It also implies that we can find the value of investment

$$I^f = \delta K^f$$

Commodity producers The primary commodity sector's share in GDP is calibrated to ω_p to match its empirical counterpart. It implies that $Y^p = \omega_p Y = \omega_p(Y^f - N^m + Y^P) = \omega_p(N^d + Y^P)$ and thus: $Y^p = \frac{\omega_p}{1-\omega_p} N^d$.

Turning to commodity producers, we know $\bar{w}^p$ and Y^p. Using once again a Normalized CES implies that

$$Y^p = r^{k,l} L^p + \bar{w} H^p + r^k K^p$$

with the following capital and labor income shares:

$$\begin{aligned} r^k K^p &= \alpha_p Y^p \\ \bar{w} H^p &= (1-\alpha_p-\beta_p) Y^p \end{aligned}$$

It implies that

$$K^p = \frac{\alpha_p Y^p}{r^k}$$

and that

$$\beta_p = 1 - \alpha_p - \frac{\bar{w} H^p}{Y^p}$$

where β_p is fixed such that the labor income share matches our assumption on hours worked in the primary sector. Therefore,

$$I^p = \delta K^p$$

and $I = I^f + I^p$, $I^m = \omega_i I$ and $I^d = (1-\omega_i) I$.

Aggregate resource constraints The aggregate resource constraint evaluated at steady state reads

$$Y^f - G = C^d + I^d + X^f$$

Plugging, steady state domestic consumption values from households yields

$$Y^f - G = (1 - \omega_c)C + I^d + X^f$$

Assuming we can calibrate the net foreign asset position $A = 0$, the assets accumulation rule gives

$$C^m + I^m + N^m = Y^p + X^f + (R - 1)\, A$$

Knowing steady state value of imported consumption we have,

$$\omega_c C + I^m + N^m = Y^p + X^f$$

We now have two equations with only X^f and C unknown. Solving yields

$$C = Y^f - (I^m + I^d + N^m + G) + Y^p$$

such that $C^m = \omega_c C$, $C^d = (1 - \omega_c)C$ and

$$X^f = (Y^f - G - C^d - I^d)$$

We have the value of aggregate consumption $C = C^s + C^e + C^r$. The consumption of rule-of-thumbs households is given by $C^r = \bar{w}H^r + tr^r$ where tr^r can be set in order to attain any objective on C^r including $C^r = C/3$. We use the same strategy for entrepreneurs by calibrating tr^e to get $C^e = C/3$.

Appendix E: Observation Equations

Here we describe our observation equations for the US/South Africa pair when estimating the model with some variables expressed in year-on-year growth rates (South Africa is an interesting choice considering the use of employment and labor compensation instead of hours worked and wages as in the US and Canada). We have a set of 20 observed variables linked to the model:

$$\begin{pmatrix} 100\log\left(GDP_t/GDP_{t-4}\right) \\ 100\log\left(CONS_t/CONS_{t-4}\right) \\ 100\log\left(INV_t/INV_{t-4}\right) \\ 100\log\left(COM_t/COM_{t-4}\right) \\ 100\log\left(EMP_t/EMP_{t-4}\right) \\ 100\log\left(EMP_t^p/EMP_{t-4}^p\right) \\ REPO_t \\ 100\log\left(CPI_t/CPI_{t-4}\right) \\ -100\log\left(NEER_t/NEER_{t-1}\right) \\ SPREAD_t \\ 100\log\left(\frac{LABCOMP_t/CPI_t}{LABCOMP_{t-4}/CPI_{t-4}}\right) \\ --- \\ 100\log\left(GDP_t^*/GDP_{t-4}^*\right) \\ 100\log\left(CONS_t^*/CONS_{t-4}^*\right) \\ 100\log\left(INV_t^*/INV_{t-4}^*\right) \\ 100\log\left(H_t^*/H_{t-4}^*\right) \\ FFR_t \\ 100\log\left(CPI_t^*/CPI_{t-4}^*\right) \\ 100\log\left(WAGE_t^*/WAGE_{t-4}^*\right) \\ SPREAD_t^* \\ 100\log\left(\frac{CP_t^*/CPI_t^*}{CP_{t-4}^*/CPI_{t-4}^*}\right) \end{pmatrix} = \begin{pmatrix} \bar{\gamma}^y \\ \bar{\gamma}^c \\ \bar{\gamma}^i \\ \bar{\gamma}^p \\ \bar{\gamma}^e \\ \bar{\gamma}^{e,p} \\ \bar{\gamma}^r \\ \bar{\gamma}^\pi \\ \bar{\gamma}^{\Delta S} \\ \bar{\gamma}^s \\ \bar{\gamma}^w \\ - \\ \bar{\gamma}^{y*} \\ \bar{\gamma}^{c*} \\ \bar{\gamma}^{i*} \\ \bar{\gamma}^{h*} \\ \bar{\gamma}^{r*} \\ \bar{\gamma}^{\pi*} \\ \bar{\gamma}^{\pi w*} \\ \bar{\gamma}^{s*} \\ \bar{\gamma}^{cp*} \end{pmatrix} + \begin{pmatrix} 100\log\left(y_t/y_{t-4}\right) \\ 100\log\left(c_t/c_{t-4}\right) \\ 100\log\left(i_t/i_{t-4}\right) \\ 100\log\left(y_t^p/y_{t-4}^p\right) \\ 100\log\left(E_t/E_{t-4}\right) \\ 100\log\left(E_t^p/E_{t-4}^p\right) \\ 400R_t \\ 100\log\left(\pi_t^c\pi_{t-1}^c\pi_{t-2}^c\pi_{t-3}^c\right) \\ 100\log\left(\Delta S_t\right) \\ 400\left(R_t^L - R_t\right) \\ 100\log\left(\frac{\bar{w}_t H_t P_t/P_t^c}{\bar{w}_{t-4}H_{t-4}P_{t-4}/P_{t-4}^c}\right) \\ --- \\ 100\log\left(y_t^*/y_{t-4}^*\right) \\ 100\log\left(c_t^*/c_{t-4}^*\right) \\ 100\log\left(i_t^*/i_{t-4}^*\right) \\ 100\log\left(H_t^*/H_{t-4}^*\right) \\ 400R_t^* \\ 100\log\left(\pi_t^*\pi_{t-1}^*\pi_{t-2}^*\pi_{t-3}^*\right) \\ 100\log\left(\pi_t^{w*}\pi_{t-1}^{w*}\pi_{t-2}^{w*}\pi_{t-3}^{w*}\right) \\ 400\left(R_t^{L*} - R_t^*\right) \\ 100\log\left(\gamma_t^{p*}/\gamma_{t-4}^{p*}\right) \end{pmatrix} + \begin{pmatrix} \epsilon_t^y \\ \epsilon_t^c \\ \epsilon_t^i \\ \epsilon_t^p \\ \epsilon_t^e \\ \epsilon_t^{e,p} \\ \epsilon_t^r \\ \epsilon_t^\pi \\ \epsilon_t^{\Delta S} \\ \epsilon_t^s \\ \epsilon_t^w \\ - \\ \epsilon_t^{y*} \\ \epsilon_t^{c*} \\ \epsilon_t^{i*} \\ \epsilon_t^{h*} \\ \epsilon_t^{r*} \\ \epsilon_t^{\pi*} \\ \epsilon_t^{\pi w*} \\ \epsilon_t^{s*} \\ \epsilon_t^{cp*} \end{pmatrix}$$

where $\bar{\gamma}$ are constants calibrated at the corresponding observed series mean. This departs from the traditional view that the trend in real variables should be identical. However, considering that trade shares have been growing in South Africa over the estimation period (starting after the end of the apartheid), and that growth rates were higher in South Africa than in the US, we decided to allow for different means in the observation equations. Similar arguments hold for average inflation and interest rates. Measurement errors ϵ are calibrated to relatively small values for all variables.

In the model, we have used hours worked while in the data only employment is available. In order to capture labor hoarding we define employment following Adolfson et al. (2007) as

$$E_t = \frac{1}{1+\beta}E_{t-1} + \frac{\beta}{1+\beta}E_{t+1} + \frac{(1-\xi_e)(1-\beta\xi_e)}{(1+\beta)\xi_e}\left(H_t - E_t\right) \tag{42}$$

where $1 - \xi_e$ is the probability of a firm to be allowed to readjust employment. We do the same for employment in the primary sector.

Appendix F: Data transformations

Some specific data transformations are detailed here. Data sources and transformations applied to other variables in Table F1.

World Commodity Prices We build a global commodity price index as an average of three sub-indexes: crude oil, metals and agricultural prices. Our index is then deflated with US CPI. The metal price index is borrowed from Barchart and includes Copper, lead and steel scraps, tin, and zinc. The agricultural price is a weighted average of agricultural raw material (26%) and food price and tropical beverage (84%) indexes from HWWI (Hamburg Institute of International Economics). These weights capture the relative importance of industrial raw materials and food in the aggregate HWWI index.

South African spread proxy We proxy the South African spread using the predicted values obtained from regressing an emerging market spread index on South African variable. The emerging market spread considered is the Option-Adjusted Spread for the ICE BofAML Emerging Markets Corporate Plus Index. The South African variables used as independent variables are the number of insolvencies, the spread between EKSOM bonds and 10-year domestic government bond yield, the spread between domestic and US 10-year government bond yield, the OECD-MEI manufacturing business confidence indicator and the OECD-MEI share price index. Figure F1(a) shows the emerging market spread index together with the fitted values from its regression on South Africa variables. The regression is performed on quarterly data over the 1999Q1 to 2019Q4 period. Predicted values are then computed based on this relation for the 1994Q1 to 2019Q4 period.

South African commodity export proxy Commodity exports are proxied by total mining sales from the Stat SA database divided by the export price index from the SARB database. Since about 70% of mining production is exported, this measure gives a good proxy of mining exports. For illustrative purposes, it is compared to the growth rate in real total exports in Figure F1(b) below. Considering the large weight of commodities in total exports, it is reassuring to see some degree of co-movements in these two variables. In a robustness exercise, we also proxy commodity exports with mining production volumes (green).

Figure F1. Data proxies

(a) Spread proxy (dashed black) compared to emerging market spread index (blue). Rates annualised.

(b) Mining export volumes proxied with mining sales (dashed black) and mining production (dashed green) compared to total exports volumes (blue). YoY growth rates.

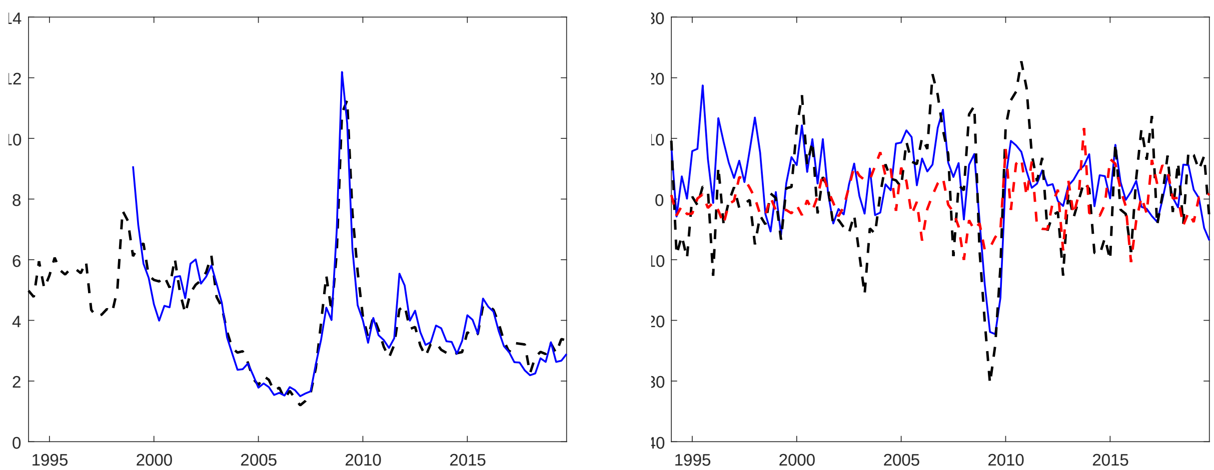


Table F1. Data sources and transformations

Data	Source	Transformation
SA GDP	Stat SA	GDP. Constant price. YoY.
SA Employment	SARB	Employment in the private sector (index). YoY.
SA Consumption	Stat SA	Final Consumption Expenditure, Households. Constant price. YoY.
SA Investment	Stat SA	Gross Fixed Capital Formation. Constant price. YoY.
SA Cmdty exports	Stat SA	Total value of mineral sales deflated by export prices. YoY.
		Note: Mining production volumes (Stat SA) in robustness check
SA Cmdty employment	SARB	Employment in mining sector. YoY.
SA CPI	Stat SA	Consumer Price Index, Urban Areas, Headline. YoY.
SA Labor comp.	Stat SA	Compensation of Employees. Deflated by CPI. YoY.
SA Risk-free rate	SARB	Repo Rate. Annual rate in level.
SA Spread	Own computations	See appendix.
SA NEER	SARB	Nominal effective exchange rate. QoQ.
CA GDP	Stat Can	GDP. Constant price. YoY.
CA Hours	Stat Can	Hours worked, Business sector. YoY.
CA Consumption	Stat Can	Final Consumption Expenditure, Households. Constant price. YoY.
CA Investment	Stat Can	Gross Fixed Capital Formation. Constant price. YoY.
CA Cmdty exports	Stat Can	Export volumes of primary commodities (categories C11 to C16). YoY.
		Note: Pre-1998: Export of primary commodities deflated by export price index
CA Cmdty employment	Stat Can	Employment in mining, oil and gas extraction. YoY.
CA CPI	Stat Can	Consumer Price Index, All items. YoY.
CA Wage	Stat Can	Compensation Per Hour Worked, Business sector. YoY.
CA Risk-free rate	Stat Can	3 Month Treasury Bills rate. Annual rate in level.
CA Spread	ICE BofA	1-5 Year BBB Canada Corporate yield minus 3 years CA treasury yield.
		Note: Backcasted pre-1997 with a regression of the spread on Canadian variables.
CA exchange rate	Stat Can	Canadian-US dollars exchange rates. QoQ.
World Cmdty Price	Own computations	See appendix
US GDP	US Bureau of Eco. Analysis	GDP. Constant price. YoY
US Consumption	US Bureau of Eco. Analysis	Personal Consumption Expenditure. Constant price. YoY.
US Investment	OECD-MEI	Gross Fixed Capital Formation. Constant price. YoY.
US Hours	US Burea of labor statistics	Hours worked, Business sector, Total Private. YoY.
US CPI	US Burea of labor statistics	Consumer Price Index, All Urban Consumers, U.S. City Average, All Items Less Shelter. YoY.
US Wage	US Burea of labor statistics	Business sector, Hourly Compensation. YoY.
US Risk-free rate	Wu and Xia (2016) and Fred	Effective Fed Fund rate replaced by its shadow rate over the 2009Q3 to 2015Q4 period.
US Spread	ICE BofA	1-3 Year BBB US Corporate Index - Option-Adj Spread. Annual rates in levels.
		Note: pre-2000: 1-3 Year BBB US Corporate yield minus 2 years US treasury yield

YoY = growth rate same quarter of the previous year. QoQ = quarter on quarter growth rate.

Appendix G: Additional DSGE results

G1. All IRFs in the full (calibrated) model

This section shows the IRFs to each categories of shocks. Figures G1.1 to G1.4 show the IRFs to foreign shocks, while figure G1.5 to G1.11 display domestic shocks. We draw a few general conclusions from this more detailed analysis. First, it demonstrates that our extended model is capable to generate a higher degree of synchronicity between the domestic and foreign economy compared to simpler versions where we shut-down our main transmission channels. The results presented in the core of the paper (with foreign wedge shocks) do not depend on the particular shock we selected but extend to most non-commodity specific shocks (which includes aggregate demand, aggregate supply, monetary, and credit supply shocks). Second, figure G1.11 illustrates why we do not use a land specific shock: for some values of σ_p, this shock would cause unrealistically high investment responses, which would impair our channel-based analysis with variance decompositions.

Figure G1.1. IRFs - Foreign aggregate supply (TFP) shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

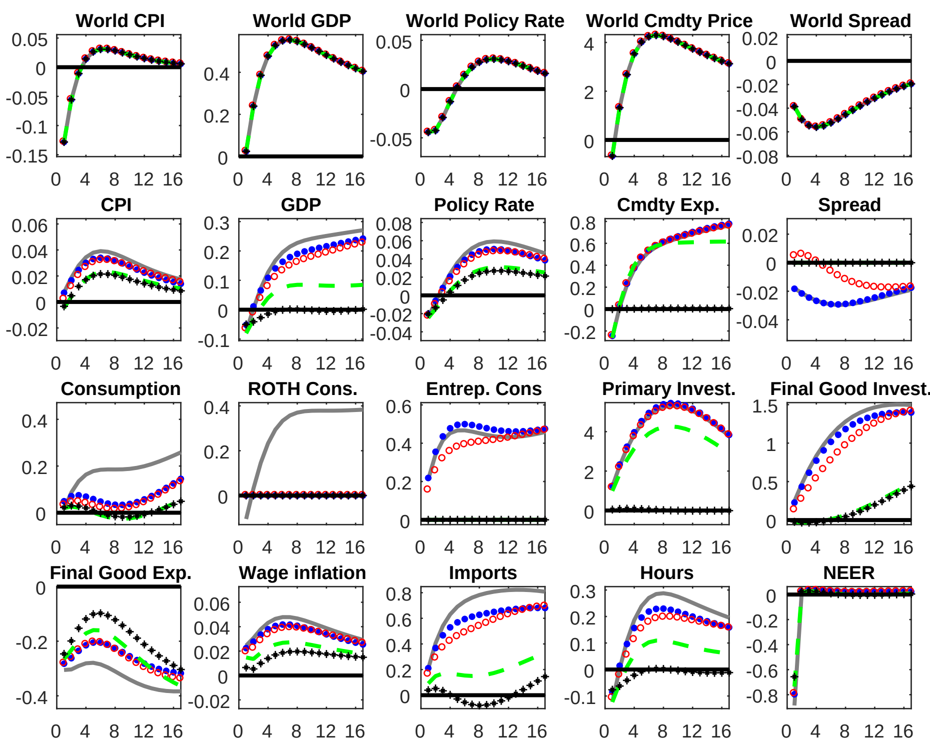


Figure G1.2. IRFs - Foreign monetary policy shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

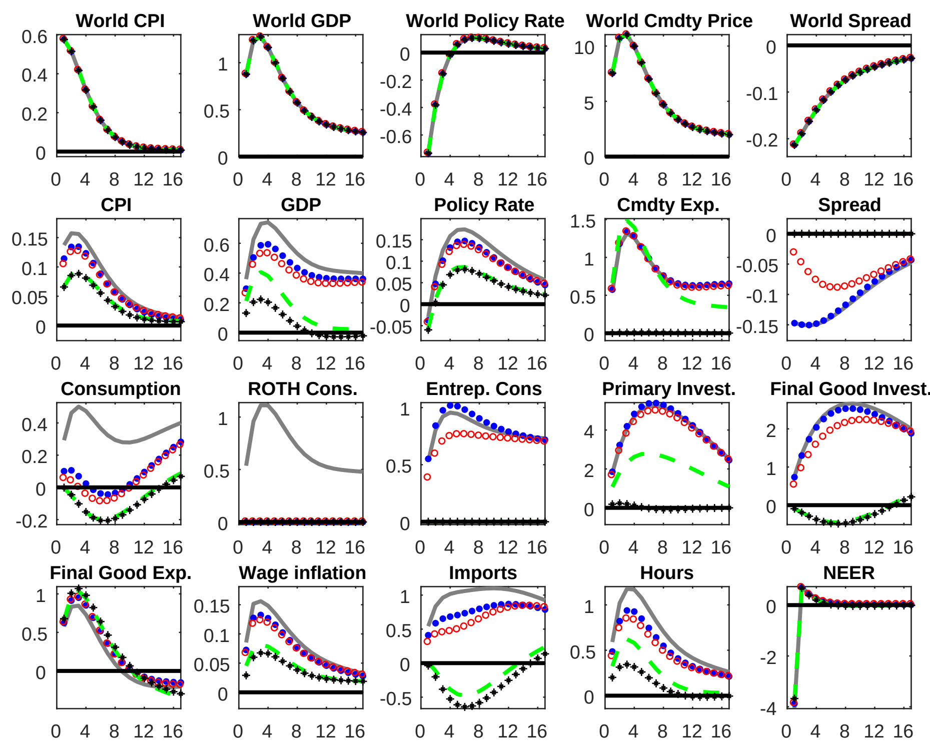


Figure G1.3. IRFs - Foreign credit supply shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

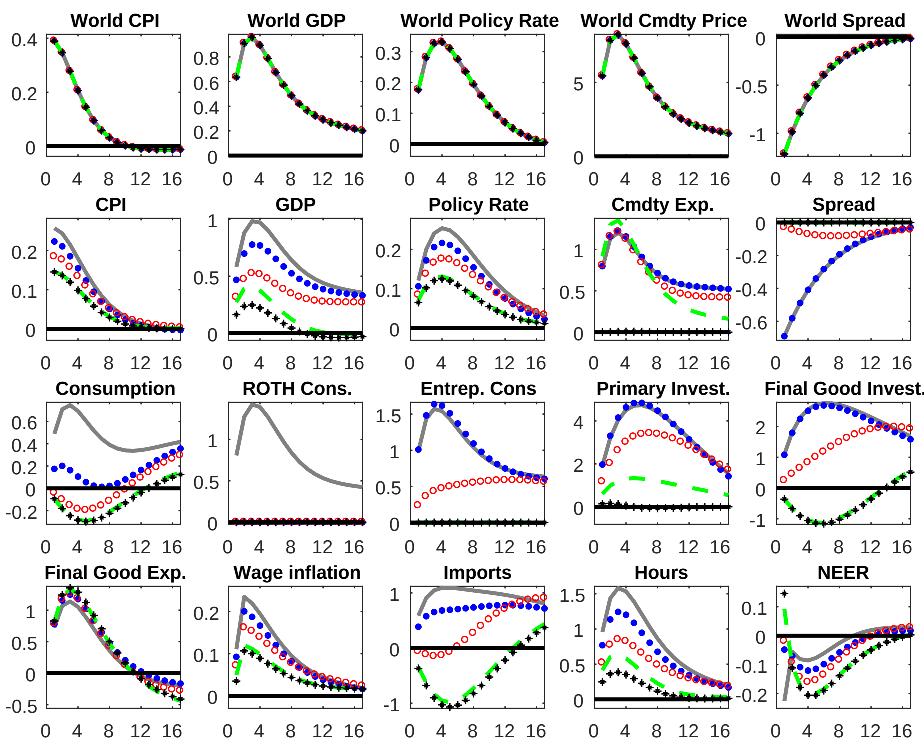


Figure G1.4. IRFs - Foreign commodity supply shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

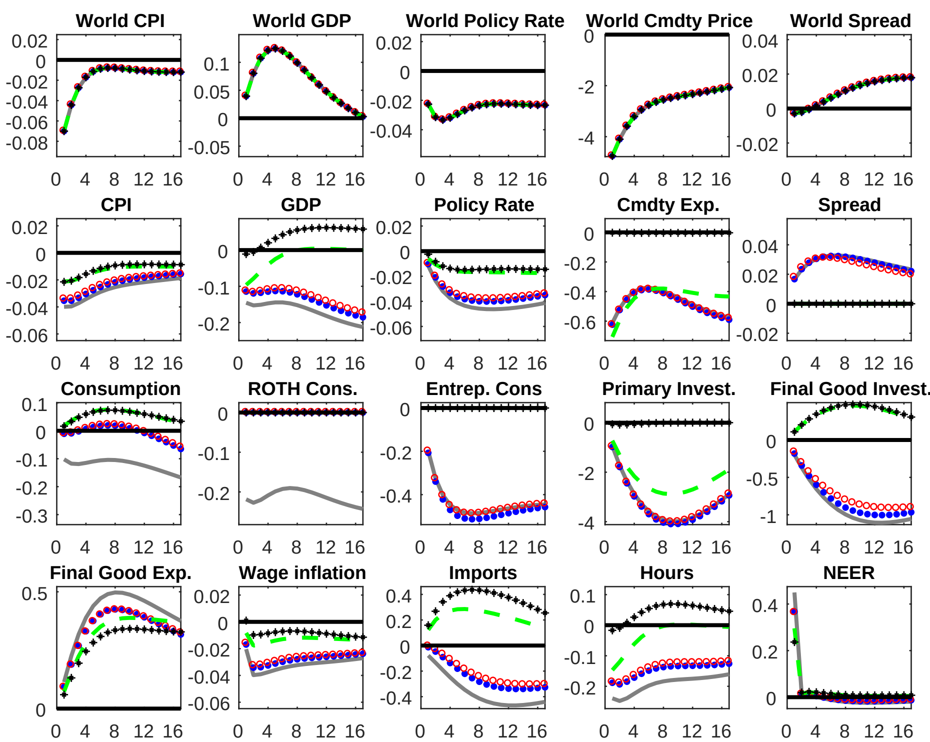


Figure G1.5. IRFs - Domestic aggregate demand (wedge) shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

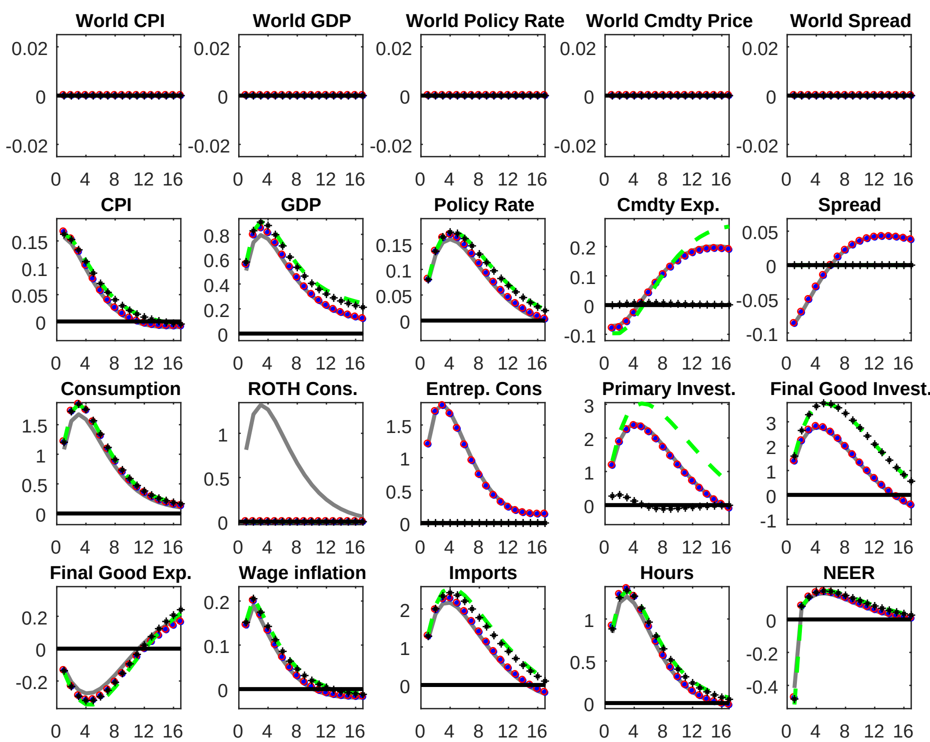


Figure G1.6. IRFs - Domestic aggregate supply (TFP final good) shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

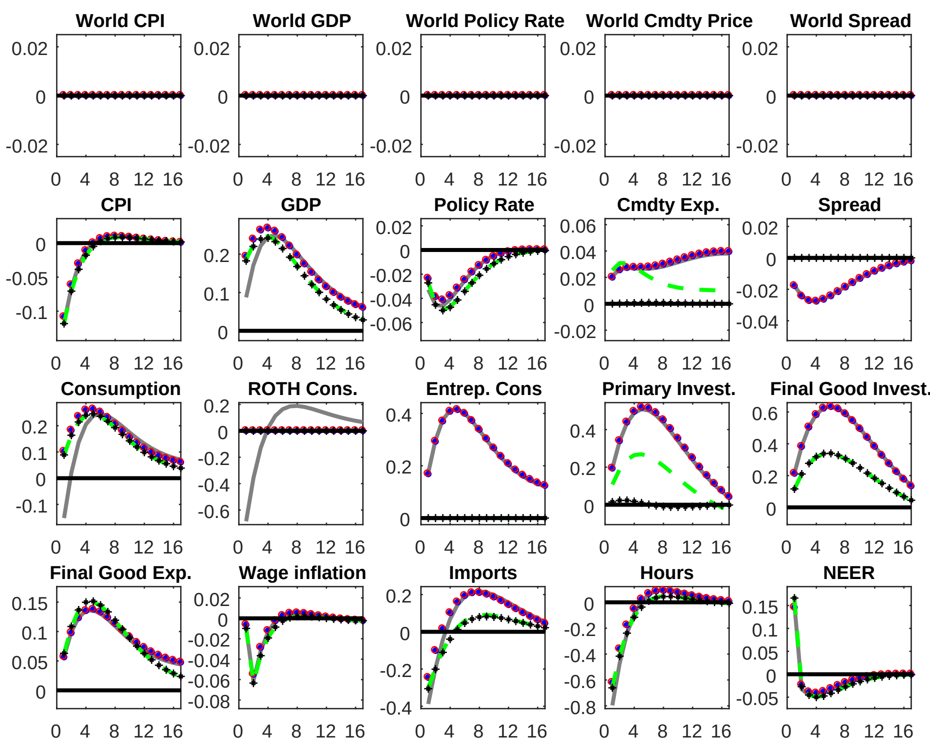


Figure G1.7. IRFs - Domestic monetary policy shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

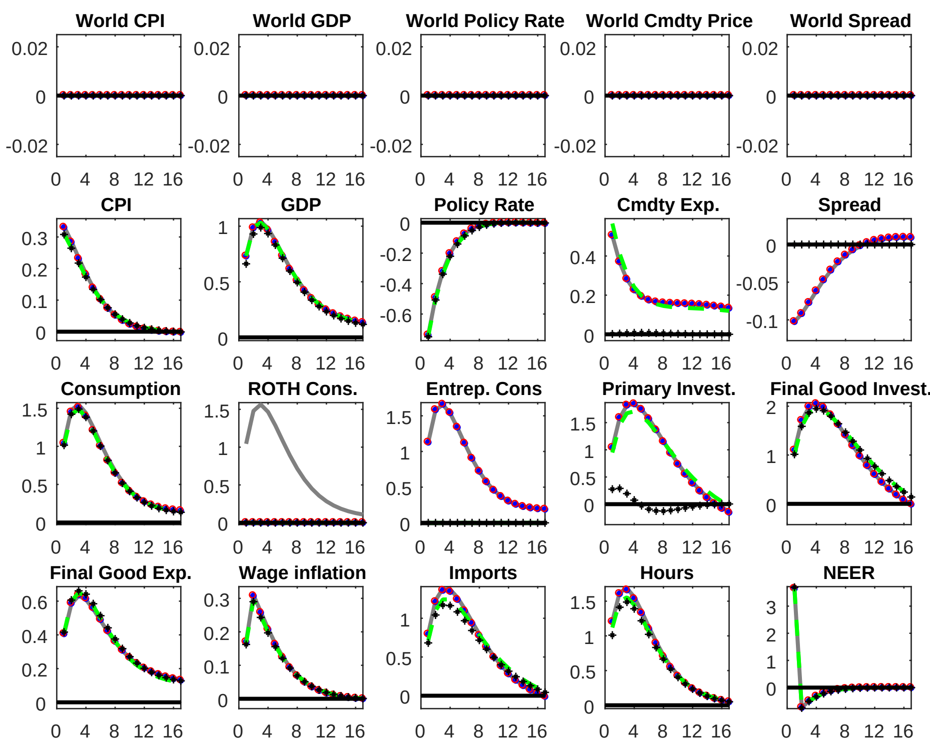


Figure G1.8. IRFs - Domestic credit supply shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

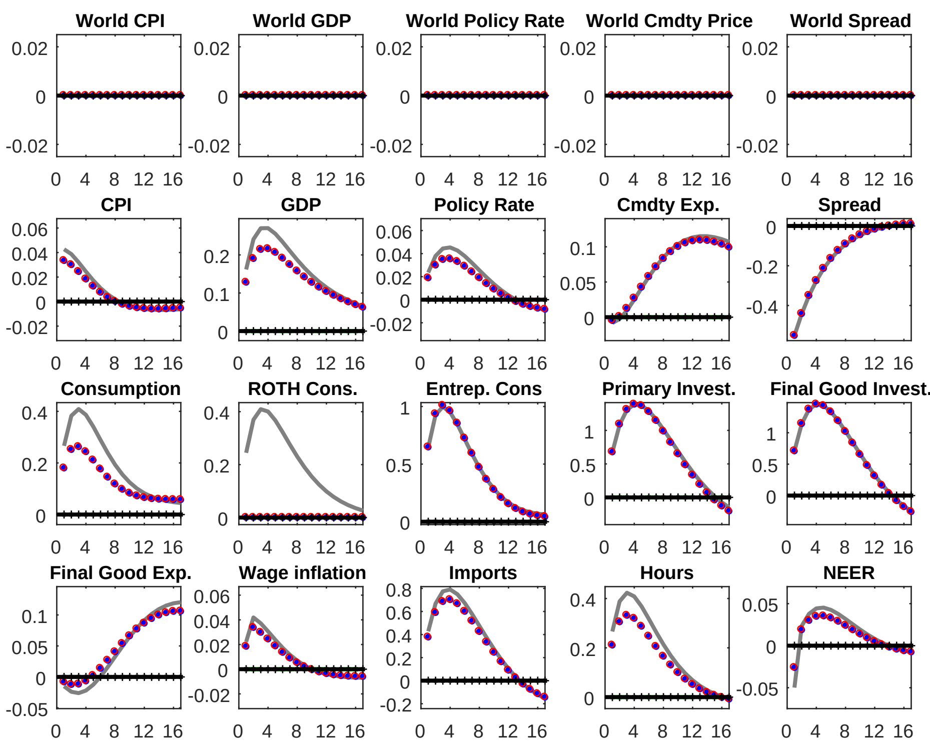


Figure G1.9. IRFs - Domestic commodity supply (labor prod) shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

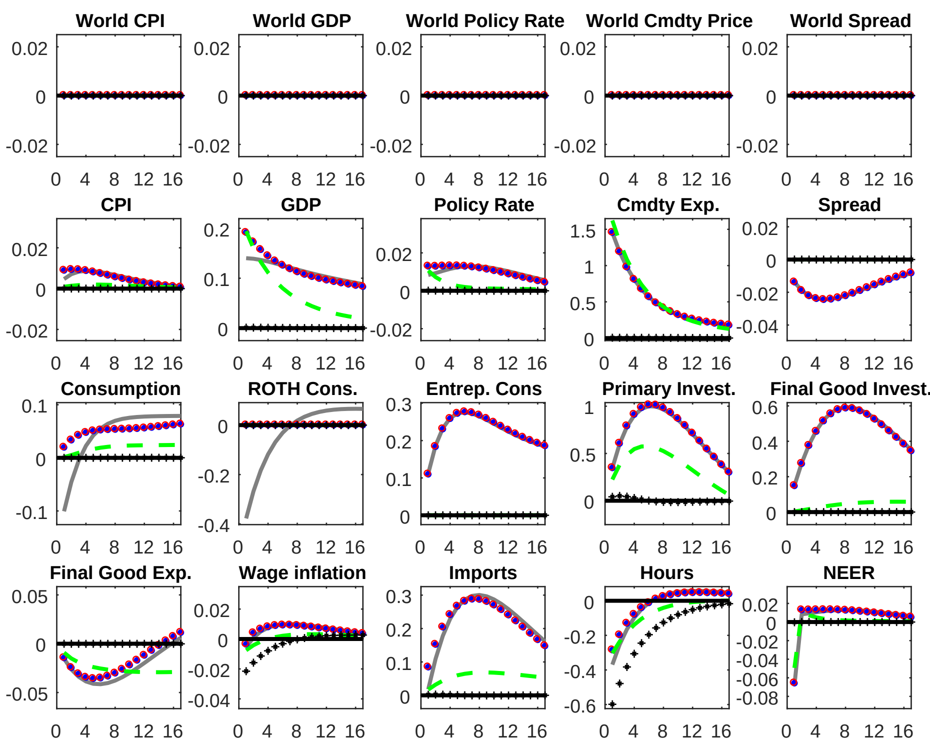


Figure G1.10. IRFs - Domestic commodity supply (land/capital prod) shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE

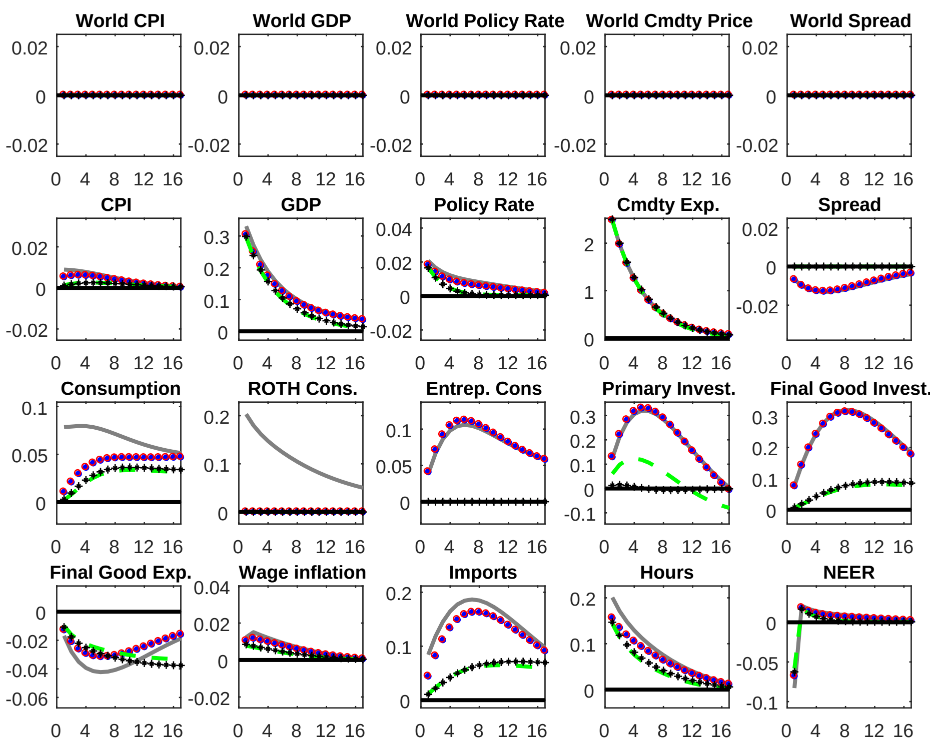
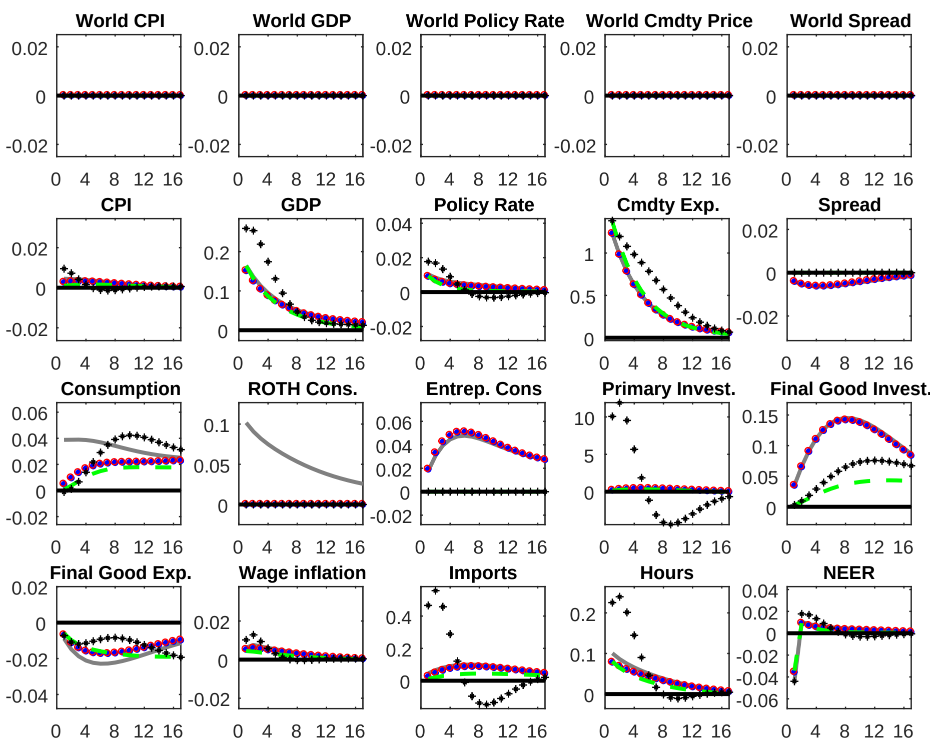


Figure G1.11. IRFs - Domestic commodity supply (land prod only) shocks in the full model

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: Full model.
Blue: Domestic and foreign banks (no ROTHs)
Red: Domestic banks only (no foreign banks, no ROTHs)
Green: No financial frictions' model (no banks, no ROTHs)
Black: No financial frictions' model + exogenous cmdty supply in the SOE



G2. Identification and the mode of key estimated parameters

Here, we briefly discuss the value of some key parameters related to our main transmission channels.

In the foreign block, the mode of the elasticity of substitution between commodity and other (labor and capital) inputs (σ_p^*) is estimated at 0.09. This parameter governs our world commodity price channel and low elasticity of substitution implies that commodity prices respond relatively strongly to the foreign business cycle through firms' demand.

In the domestic block, we estimate the elasticity of substitution between production factors in the primary sector (σ_p) and find values of 0.21 and 0.15 for South Africa and Canada, respectively. The use of a CES production function with decreasing returns to scale (due to the introduction of a fixed production factor), a low labor income share (0.37 and 0.23) and a low factor elasticity of substitution between production factors imply short-run domestic commodity supply price-elasticities of 0.12 and 0.04 in these economies.

The estimated share of foreign banks (ω_b) is 0.76 in South Africa (much larger than its prior mean of 0.22) and 0.40 in Canada (close to its prior mean). The lower estimate value in Canada may come as a surprise, considering the higher prior value, the close links with the US, and the large observed correlation between Canadian and US spreads. Here, the relative volatility of the Canadian and US spreads explains those results. In our data, the US spread is more volatile and a large share of foreign banks in Canada would result in overfitting the Canadian spread volatility. The estimation thus captures the trade-off between the high observed correlation in the spread with the different volatilities. Nevertheless, the estimation does a decent job at reproducing the correlation between the Canadian and US spreads.

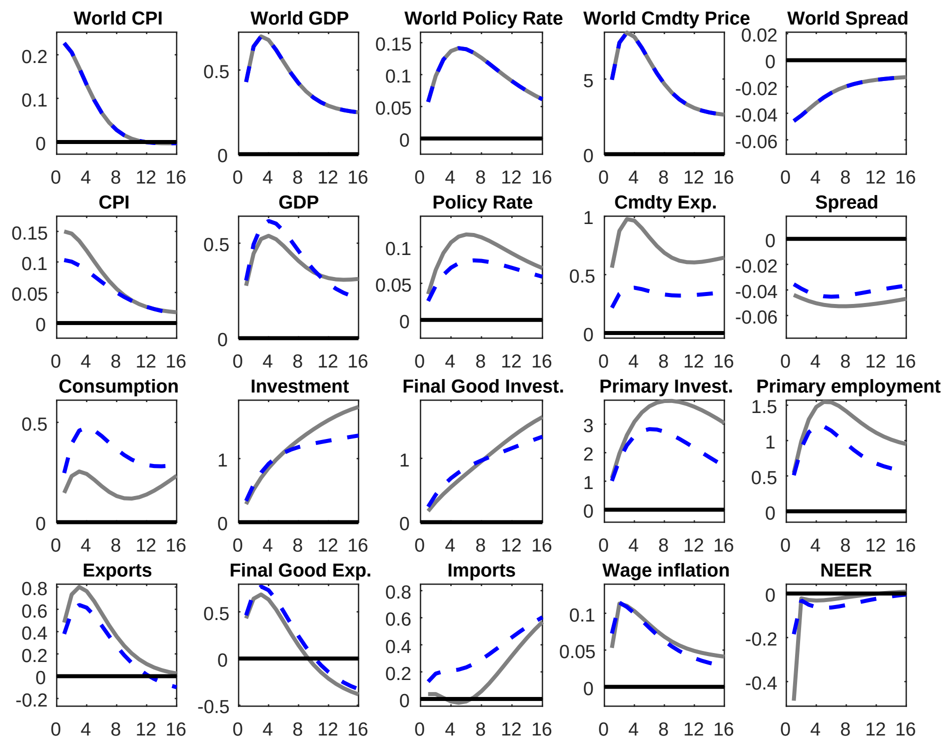
We estimate a low value for the spread elasticity to borrower net worth ratio in the domestic (ϕ_{nw}) and foreign (ϕ_{nw}^*) economies (fixing their prior mean to 0.05; e.g. as in Bernanke et al., 1999) to about 0.025 in South Africa, 0.030 in Canada and 0.031 in the US. Other papers also report a low spread elasticity to net worth ratio. Alpanda and Aysun (2014) report low values for the US and Euro Area. In Christiano et al. (2014), risk shocks explain 95% of the fluctuations in the spread, while the endogenous response of net worth to other shocks only accounts for 5%, in an estimated model with US data.

Finally, the methodologies proposed by Andrle (2010) and Iskrev (2010) implemented in Dynare show that key estimated parameters (σ_p^*, σ_p, ω_b, ϕ_{nw} and ϕ_{nw}^*) governing our three main transmission channels are well identified.

G3. Aggregate demand shocks in the estimated model

Figure G1. IRFs - Foreign aggregate demand shocks: South Africa (grey) and Canada (blue)

Note: Variables expressed in percentage deviation from steady-state, inflation rates, interest rates and spreads annualized. Horizon in quarters.
Grey: South Africa.
Blue: Canada



G4. Variance decomposition: South Africa and the OECD + BRIIC

Here, we present our variance decomposition analysis for South Africa, where the foreign economy is captured by an OECD plus BRIIC (Brazil, Russia, India, Indonesia, and China) aggregate. Specifically, we build weighted averages for foreign variables, where the weights are based on every countries' GDPs. Exceptions are made for the interest rate and spread, for which we keep US data. US risk-free rates and spreads have a major importance to the world economy. Moreover, in the case of the spreads, data availability also dictated that choice. The following table shows that our results are robust to using an alternative characterization of the foreign economy: foreign shocks remains important drivers for South African variables.

Table G3. Foreign shocks contribution to foreign and domestic variables

South Africa	AD*	AS*	MP*	Com*	Cred*	All*
GDP	11.14	2.86	2.21	1.88	4.19	22.28
Employment	15.65	1.89	3.24	2.25	6.25	29.28
Consumption	4.05	5.95	1.33	0.96	2.66	14.95
Investment	2.42	7.55	1.50	1.04	2.09	14.60
Exports	15.24	4.08	2.33	2.78	2.41	26.84
Imports	2.50	7.00	0.70	0.51	0.86	11.57
Mining exports	8.10	4.79	1.59	3.38	1.38	19.24
Mining Empl	17.31	7.82	3.49	3.41	3.28	35.31
CPI	25.76	3.30	1.98	1.70	3.78	36.52
Wage	8.57	2.86	2.10	1.74	3.63	18.90
Risk-free rate	33.23	6.37	1.74	1.98	3.35	46.67
Spread	17.73	5.66	1.99	2.15	18.53	46.06
NEER	1.15	9.27	3.89	0.54	0.42	15.27
OECD + BRIIC	AD*	AS*	MP*	Com*	Cred*	All*
GDP	50.99	19.34	14.97	3.96	9.89	99.15
Consumption	48.59	20.01	14.70	5.82	10.43	99.55
Investment	48.17	23.00	18.86	2.41	7.18	99.62
Hours	53.60	12.87	9.03	6.57	17.23	99.30
CPI	74.29	6.92	10.09	2.00	5.92	99.22
Wage	65.46	21.75	7.31	1.03	3.77	99.32
Risk-free rate	86.98	2.51	3.09	1.78	4.86	99.22
Spread	8.42	26.80	2.24	2.32	59.56	99.34
(World) Commodity Price	43.62	15.14	12.87	19.35	8.49	99.47

Note: Risk-free rate and spread in levels; NEER in Q/Q growth rate; all other variables in Y/Y growth rates. Stars stand for foreign shocks. See the methodology section of the paper for a description of the shocks classification. The last column is the total contribution of all foreign shocks. South Africa data in the upper panel and the foreign economy (OECD+BRIIC) in the lower panel. Note that the sum of variances does not add up to 100 due to the inclusion of small calibrated measurement errors in the estimation.

G5. MCMC: Correlations and VD with parameter uncertainty

Table G5.1 Variance decomposition: 90% confidence bands for South Africa-US

	AD*	AS*	MP*	Com*	Cred*	All*
GDP	[7.75, 16.76]	[1.38, 2.79]	[0.95, 2.53]	[3.20, 7.95]	[2.08, 4.57]	[17.64, 31.23]
Employment	[10.14, 21.27]	[1.07, 2.32]	[1.31, 3.39]	[4.22, 10.30]	[2.01, 4.83]	[21.71, 37.54]
Consumption	[1.91, 4.76]	[0.62, 1.92]	[0.44, 1.31]	[1.72, 4.72]	[1.15, 2.86]	[6.87, 13.87]
Investment	[1.16, 4.97]	[2.10, 6.74]	[0.78, 2.56]	[1.28, 4.59]	[3.17, 8.64]	[10.47, 24.17]
Exports	[14.68, 28.99]	[1.30, 2.92]	[0.78, 3.69]	[2.39, 6.49]	[3.10, 6.16]	[25.29, 44.20]
Imports	[0.99, 4.07]	[1.02, 3.30]	[0.25, 1.10]	[0.37, 2.09]	[0.50, 1.72]	[4.44, 9.64]
Mining exports	[2.71, 8.64]	[1.37, 3.68]	[0.40, 1.35]	[0.52, 1.95]	[3.11, 8.14]	[9.07, 21.99]
Mining Empl	[7.37, 21.38]	[2.67, 6.86]	[1.27, 3.82]	[1.49, 5.22]	[5.33, 13.76]	[20.98, 46.23]
CPI	[12.03, 25.50]	[1.38, 3.74]	[0.97, 2.56]	[2.24, 7.29]	[3.24, 8.58]	[23.42, 41.90]
Wage	[5.76, 13.20]	[1.11, 2.36]	[0.86, 2.34]	[2.62, 6.68]	[1.54, 3.73]	[13.74, 25.60]
Risk-free rate	[12.51, 28.50]	[2.41, 6.24]	[0.88, 2.44]	[2.09, 7.29]	[5.51, 12.96]	[28.59, 49.88]
Spread	[8.31, 20.14]	[1.46, 4.71]	[0.99, 2.93]	[19.34, 39.55]	[5.76, 12.83]	[41.73, 69.51]
NEER	[0.07, 0.98]	[1.31, 4.32]	[2.77, 6.40]	[0.02, 0.40]	[1.24, 3.81]	[6.75, 13.71]
US GDP	[43.08, 60.55]	[12.80, 23.28]	[9.08, 17.36]	[7.55, 16.69]	[3.04, 8.38]	[99.42, 99.64]
US Hours	[42.91, 59.04]	[15.34, 25.56]	[8.99, 17.20]	[7.69, 16.70]	[1.94, 5.49]	[99.53, 99.72]
US Consumption	[42.26, 61.56]	[12.19, 22.68]	[11.49, 21.87]	[6.24, 13.52]	[2.73, 7.56]	[99.53, 99.73]
US Investment	[32.51, 50.54]	[16.73, 28.45]	[5.65, 11.72]	[12.84, 29.29]	[3.74, 9.76]	[98.95, 99.38]
US CPI	[45.48, 63.61]	[8.54, 16.76]	[12.70, 25.47]	[5.18, 14.26]	[2.93, 6.97]	[99.58, 99.79]
US Wage	[17.07, 37.15]	[45.14, 70.21]	[5.76, 14.75]	[1.63, 5.65]	[0.99, 2.86]	[99.29, 99.58]
US Risk-free rate	[62.92, 80.77]	[2.07, 4.62]	[3.57, 8.68]	[5.65, 16.67]	[3.80, 10.21]	[97.81, 98.87]
US Spread	[3.72, 12.41]	[5.14, 12.52]	[0.66, 2.65]	[63.57, 80.99]	[5.77, 13.40]	[98.91, 99.37]
Commodity Price	[24.85, 42.18]	[8.05, 15.12]	[5.44, 11.38]	[4.79, 10.81]	[28.79, 50.37]	[99.05, 99.42]

Note: Risk-free rate and spread in levels; NEER in Q/Q growth rate; all other variables in Y/Y growth rates. Stars stand for foreign shocks. See the methodology section of the paper for a description of the shocks classification. The last column is the total contribution of all foreign shocks. We compute 90% confidence bands. From a MCMC chain of 200 000 draws, we burn the first half and then select 1 000 draws with equal spacing.

Table G5.2 Variance decomposition: 90% confidence bands for Canada-US

	AD*	AS*	MP*	Com*	Cred*	All*
GDP	[18.32, 32.04]	[1.64, 3.30]	[1.21, 3.43]	[4.70, 12.38]	[2.18, 5.08]	[32.30, 49.82]
Employment	[20.24, 34.36]	[1.40, 2.81]	[1.35, 3.84]	[5.24, 13.44]	[2.02, 5.25]	[34.76, 52.70]
Consumption	[6.60, 16.22]	[1.01, 3.33]	[1.09, 3.39]	[3.51, 9.43]	[4.66, 11.24]	[20.79, 37.33]
Investment	[1.72, 8.20]	[2.30, 6.85]	[1.11, 3.59]	[1.92, 8.43]	[4.31, 11.03]	[15.08, 31.27]
Exports	[24.88, 41.44]	[2.15, 5.56]	[0.20, 2.48]	[2.97, 8.59]	[5.56, 12.25]	[41.78, 60.44]
Imports	[1.38, 4.53]	[1.79, 5.61]	[0.53, 2.18]	[0.91, 4.84]	[1.39, 4.21]	[7.97, 18.01]
Mining exports	[1.20, 4.98]	[0.75, 2.74]	[0.20, 0.79]	[0.22, 1.15]	[1.33, 5.25]	[4.01, 13.81]
Mining Empl	[5.92, 19.63]	[1.41, 4.49]	[0.88, 3.28]	[1.03, 4.65]	[3.40, 11.79]	[13.97, 40.21]
CPI	[17.63, 34.19]	[2.25, 6.27]	[1.29, 3.39]	[2.82, 11.85]	[5.35, 14.66]	[36.94, 58.64]
Wage	[12.54, 26.98]	[2.82, 7.75]	[1.33, 3.50]	[2.40, 9.44]	[6.19, 15.31]	[32.20, 52.37]
Risk-free rate	[14.84, 31.99]	[3.39, 9.53]	[0.94, 3.02]	[2.32, 10.87]	[8.84, 23.12]	[39.31, 64.17]
Spread	[9.86, 23.84]	[2.56, 9.30]	[1.13, 3.92]	[8.01, 23.01]	[14.84, 32.01]	[48.98, 72.38]
NEER	[0.31, 2.44]	[2.27, 7.92]	[8.59, 16.58]	[0.04, 0.78]	[3.46, 10.88]	[18.04, 32.18]
US GDP	[47.38, 64.61]	[11.49, 21.10]	[8.47, 17.23]	[6.32, 15.76]	[2.59, 7.42]	[99.42, 99.66]
US Hours	[46.34, 61.79]	[14.74, 25.16]	[8.23, 16.99]	[6.21, 15.64]	[1.73, 4.84]	[99.55, 99.73]
US Consumption	[46.99, 65.80]	[11.63, 21.85]	[10.58, 21.69]	[4.49, 11.35]	[2.15, 6.12]	[99.52, 99.73]
US Investment	[34.14, 52.87]	[14.58, 26.21]	[5.37, 11.57]	[11.60, 32.03]	[3.62, 9.82]	[98.98, 99.42]
US CPI	[44.23, 62.10]	[8.28, 16.67]	[12.02, 25.09]	[5.35, 17.74]	[3.28, 8.84]	[99.59, 99.80]
US Wage	[15.81, 35.17]	[45.27, 70.97]	[5.71, 13.87]	[1.83, 8.01]	[1.46, 4.67]	[99.27, 99.59]
US Risk-free rate	[56.14, 76.43]	[2.31, 4.73]	[3.79, 8.85]	[6.23, 22.57]	[4.30, 13.97]	[97.78, 98.79]
US Spread	[5.27, 14.96]	[4.88, 12.30]	[0.71, 2.95]	[61.23, 80.24]	[5.17, 13.13]	[99.15, 99.54]
Commodity Price	[27.60, 45.36]	[7.84, 14.31]	[5.11, 11.68]	[3.83, 10.52]	[27.27, 49.39]	[99.07, 99.45]

Note: Risk-free rate and spread in levels; NEER in Q/Q growth rate; all other variables in Y/Y growth rates. Stars stand for foreign shocks. See the methodology section of the paper for a description of the shocks classification. The last column is the total contribution of all foreign shocks. We compute 90% confidence bands. From a MCMC chain of 200 000 draws, we burn the first half and then select 1 000 draws with equal spacing.

Table G5.3 Correlation between domestic variables and foreign GDP, cmdty prices and spread: 90% confidence bands

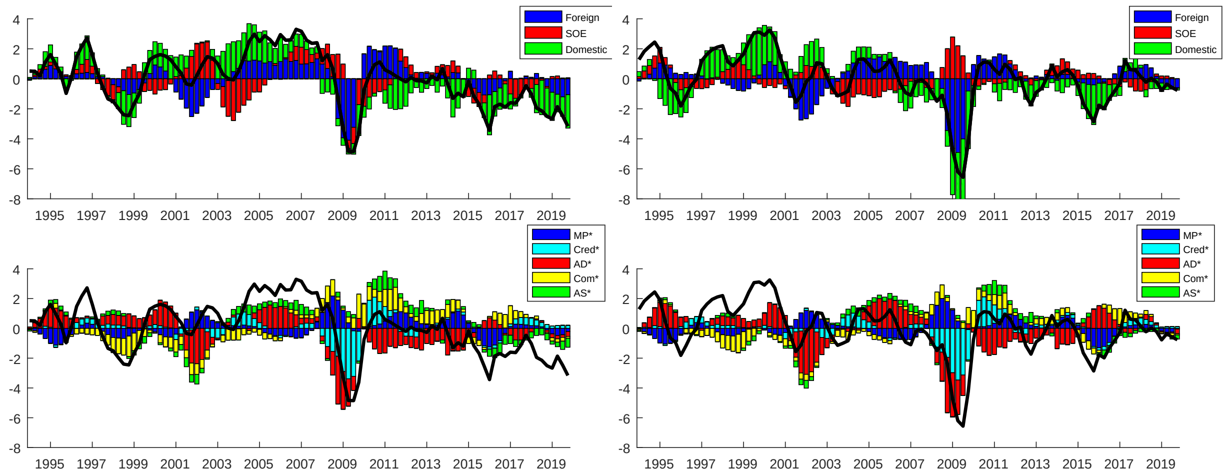
	Corr(x,GDP*)		Corr(x,CP*)		Corr(x,spr*)	
South Africa	Data	DSGE	Data	DSGE	Data	DSGE
GDP	0.37	$[0.28, 0.44]$	0.60	$[0.38, 0.52]$	-0.35	$[-0.23, -0.14]$
Employment	0.22	$[0.32, 0.48]$	0.38	$[0.40, 0.54]$	-0.40	$[-0.26, -0.17]$
Consumption	0.41	$[0.09, 0.20]$	0.51	$[0.17, 0.29]$	-0.48	$[-0.17, -0.10]$
Investment	0.14	$[0.00, 0.14]$	0.21	$[0.16, 0.26]$	-0.20	$[-0.26, -0.12]$
Exports	0.53	$[0.37, 0.58]$	0.36	$[0.33, 0.54]$	-0.56	$[-0.20, -0.11]$
Imports	0.46	$[-0.05, 0.10]$	0.49	$[-0.02, 0.15]$	-0.52	$[-0.18, -0.09]$
Mining exports	0.31	$[0.12, 0.27]$	0.54	$[0.25, 0.43]$	-0.40	$[-0.17, -0.11]$
Mining Empl.	-0.17	$[0.25, 0.44]$	0.49	$[0.37, 0.57]$	0.02	$[-0.24, -0.14]$
CPI	-0.22	$[0.09, 0.21]$	-0.13	$[0.14, 0.24]$	0.29	$[-0.33, -0.18]$
Labor compensation	0.25	$[0.25, 0.38]$	0.46	$[0.33, 0.46]$	-0.25	$[-0.17, -0.10]$
Risk-free rate	0.34	$[-0.10, -0.03]$	-0.10	$[-0.06, 0.00]$	-0.09	$[-0.29, -0.09]$
Spread	-0.28	$[-0.17, -0.07]$	-0.48	$[-0.13, -0.05]$	0.64	$[0.62, 0.78]$
NEER	0.02	$[-0.07, -0.02]$	-0.17	$[-0.12, -0.07]$	-0.16	$[0.10, 0.14]$
Canada	Data	DSGE	Data	DSGE	Data	DSGE
GDP	0.78	$[0.44, 0.60]$	0.41	$[0.49, 0.64]$	-0.60	$[-0.30, -0.20]$
Hours	0.75	$[0.46, 0.62]$	0.45	$[0.51, 0.66]$	-0.66	$[-0.25, -0.16]$
Consumption	0.58	$[0.27, 0.44]$	0.60	$[0.39, 0.55]$	-0.51	$[-0.27, -0.17]$
Investment	0.65	$[0.08, 0.28]$	0.59	$[0.23, 0.38]$	-0.55	$[-0.31, -0.16]$
Exports	0.82	$[0.48, 0.70]$	0.25	$[0.27, 0.50]$	-0.67	$[-0.25, -0.12]$
Imports	0.78	$[0.05, 0.27]$	0.65	$[0.07, 0.31]$	-0.64	$[-0.28, -0.15]$
Mining exports	0.65	$[0.09, 0.22]$	0.38	$[0.16, 0.32]$	-0.62	$[-0.18, -0.11]$
Mining Empl.	0.22	$[0.28, 0.48]$	0.44	$[0.37, 0.59]$	-0.24	$[-0.23, -0.14]$
CPI	0.06	$[0.17, 0.29]$	0.43	$[0.16, 0.27]$	-0.07	$[-0.49, -0.33]$
Wage	0.18	$[0.08, 0.20]$	0.05	$[0.07, 0.18]$	-0.15	$[-0.42, -0.26]$
Risk-free rate	0.48	$[-0.07, 0.00]$	0.17	$[-0.07, -0.01]$	-0.32	$[-0.43, -0.24]$
Spread	-0.70	$[-0.21, -0.11]$	-0.39	$[-0.17, -0.07]$	0.75	$[0.57, 0.73]$
NEER	0.00	$[-0.09, -0.02]$	-0.32	$[-0.18, -0.10]$	-0.02	$[0.09, 0.15]$

Note: Risk-free rate and spread in levels; NEER in Q/Q growth rate; all other variables in Y/Y growth rates. Stars stand for foreign variables. South Africa data in the upper panel and Canada in the lower panel. The second column displays the correlation between foreign GDP and domestic variables listed in the first column. The third column shows the correlation between world commodity prices and domestic variables. The fourth column shows the correlation between foreign spread and domestic variables We compute 90% confidence bands. From a MCMC chain of 200 000 draws, we burn the first half and then select 1 000 draws with equal spacing.

G6. Historical decomposition

Figure G6. Historical Decomposition:

(a) South African GDP (b) Canadian GDP



Historical decomposition shows the role that structural shocks have played during key episodes. Figure G6 displays the historical decomposition for GDP in South Africa and Canada. The upper panels highlight the contributions of domestic, foreign, and SOE shocks. The lower panels we present a detailed analysis across foreign shocks. Adverse commodity price shocks of the late 1990s (that coincided with the Asian financial crisis of 1997) had a negative impact on GDP growth in South Africa and Canada. In this period, South Africa also suffered from a Rand crisis. The SARB responded by tightening its monetary policy: the policy rate increased by almost 700 basis points in the space of six months, which contributed to amplifying the crisis. In contrast, domestic developments were supportive for activity in Canada. In the early 2000's, the burst of the dot-com bubble weighted on growth in South Africa and Canada with a negative contribution of foreign aggregate demand shocks. In the recovery phase that followed, strong foreign demand contributed to the sustained growth in these economies. The global financial crisis (GFC) of 2007/2008 and the great recession that followed translated into the largest drop in South African and Canadian GDP growth via adverse foreign aggregate demand and credit shocks, and their associated effects on commodity demand. Even though foreign monetary policy was accommodative, the total contribution of foreign shocks to domestic (year-on-year) GDP growth sunk to -4% in both economies at the depth of the GFC. Subsequently, favorable commodity supply shocks - together with positive monetary and credit supply shocks that possibly capture the impact of quantitative easing - contributed to the 2011 recovery before the recent commodity price reversal (with the contribution of foreign commodity supply shocks reaching a trough in 2015). The contribution of foreign monetary policy, which was accommodative until then, later turned into negative effects when the Fed started to increase its interest rate in late-2015. South African specific factors also contributed to the low GDP growth since 2015, while Canadian specific shocks contributed the low growth registered in 2016.

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